

IMPERIAL MYCOLOGICAL INSTITUTE

REVIEW OF APPLIED MYCOLOGY

VOL. XVIII

DECEMBER

1939

GUBA (E. F.). **Control of Tomato leaf mold in greenhouses.**—*Bull. Mass. agric. Exp. Sta.* 361, 36 pp., 7 figs., 1939.

In Massachusetts leaf mould of tomatoes (*Cladosporium fulvum*) [R.A.M., xviii, p. 637] is stated to be of importance only in greenhouses, where it is associated with the high temperatures and high relative humidities prevailing during the warm months of the year and occurs when the difference between the inside and outside mean minimum temperatures is least. Recommendations for the control of the disease include proper spacing; leaf pruning below the fruit; not too excessive bottom watering, permitting the foliage to be kept dry, done preferably in the morning and on bright days to ensure dry conditions at night; and finally ventilation and heating in order to maintain minimum temperatures between 60° and 65° F. in the spring and early autumn and free ventilation throughout the milder months. In control demonstrations, based on the above-mentioned recommendations, the percentage of diseased leaflets, tabulated at each pruning, was in some seasons considerably lower under good than under poor management, while in other seasons the difference was not significant. Comparative experiments with air-conditioning apparatus did not justify its installation, while the advantages of minimum thermostatic temperature control over hand valve control in greenhouses are recognized. Greenhouse design and location are important factors in control. Adequate ventilation and air circulation are ensured in single greenhouses, built without the connecting covered alley, all of glass, with a high ridged, even-span roof, and continuous ventilation on sides, ends, and span, situated in exposed, unsheltered positions.

The vaporization of sulphur beginning in April and continued at intervals of about 10 days until the end of June and then again before planting in the autumn until early November is recommended. The sulphuring of the hot steam pipes is rejected as the pipes are usually only hot enough to make the sulphur fume and consequently the greenhouses must be closed for a considerable length of time, which encourages the progress of the disease. The use of fungicidal sprays and dusts is considered to be ineffective, giving an inadequate protection for the lower surfaces of the leaves.

Disinfection of the greenhouse interior with chemical fumigants, of which burning sulphur has received most recognition for being

economical, practical, and lethal both to fungi and most insects, should be done just before the finished planting is cleaned out. The burning of sulphur at the rate of 4 lb. to 10,000 cu. ft. under dry conditions is considered to be safe, whereas greater quantities are harmful to iron frames and piping, wires, metal gutters, and paints containing zinc, the resulting residues dissolving in dripping water and causing injury to succeeding plantings. For these reasons only paints free from zinc and tinned or uncoated steel trellis wires should be used. Formaldehyde vapours were found to be inert to paint and metal, but lethal to the fungus. In a greenhouse of 10,000 cu. ft. a dosage of 24 fluid oz. of formaldehyde and 20 oz. of potassium permanganate, with 24 hours exposure to the vapour, killed both fungal spores and plants. The cost of this treatment was about 53 cents as compared with 16 for sulphur at the rate suggested. The use of formaldehyde as a soil-sterilizing agent combined with carbon disulphide emulsion against nematodes (exposure for two to three days) produces a greenhouse atmosphere strongly lethal to fungus spores and most insects.

BIER (J. E.). **Septoria canker of introduced and native hybrid Poplars.**—*Canad. J. Res.*, Sect. C., xvii, 6, pp. 195–204, 5 pl., 1939.

Septoria musiva Peck, a common leaf-spotting fungus of poplars in North America, has been observed causing a destructive canker on the introduced hybrids *Populus rasumovskiyana*, *P. petrowskyana*, and *P. berolinensis* (of Russian origin), and the native hybrids between *P. tacamahacca* and *P. balsamifera* known as North-west and Saskatchewan poplars in Saskatchewan and Ontario. The affected trees show a number of lesions on the trunk and branches which ultimately girdle and kill the affected parts; the trees also form numerous new branches from adventitious buds on the stem and frequently sucker shoots that may develop into trees later. In addition to cankers, leaf lesions appear three or four weeks after the opening of the buds, at first on the leaves of the lower branches only, but infection rapidly spreads throughout the tree, though without causing defoliation. These lesions may be circular or angular and are brown with yellowish to white centres. They may coalesce to involve large areas of the leaf.

Field observations and artificial inoculations showed that cankers originate in the bark of twigs of the current year, the fungus entering the host through mechanical wounds and uninjured lenticels, stipules, and leaf petioles. By the middle of June one or more dead leaves may be observed on the leaders, at the ring scars, or on the axillary branches. The diseased bark is usually black with yellowish to white areas in which small pycnidia may be found. Girdled branches usually die during the first growing season, the infection then spreading to the main stem, where the perennial cankers develop, which ultimately kill the tree during its fourth or fifth year of growth.

The pycnidia, which vary in width from 64 to 120 μ (average 88 μ), and in height from 68 to 129 μ (average 96 μ), are embedded in the tissues, with projecting ostioles. The pycnosporos are discharged in long, curled, pinkish cirrhi; they are hyaline, continuous to four- (mostly two-) septate, 17.2 to 57 by 3 to 4 μ . In late August, September, and October, small pycnidia, which are apparently spermogonial

structures, filled with rod-shaped, one-celled, hyaline spores, 4 to 7 by 1 to 2 μ , are found on the lesions. The perfect stage of the fungus was identified as a species of *Mycosphaerella* with cylindrical, short-stipitate, eight-spored asci, 51 to 73 by 12 to 17 μ , and hyaline, uniseptate ascospores 17 to 24 by 4 to 6 μ . *S. musiva* is considered to be indigenous to North America and is not known to occur elsewhere. In addition to the cankers combined with leaf spot caused on the above-mentioned hosts, the fungus was also found to produce leaf injury on cottonwood (*P. balsamifera*), aspen (*P. tremuloides*), *P. tacamahacca*, *P. candicans*, and *P. trichocarpa* in Quebec, Ontario, Manitoba, Saskatchewan, and Alberta.

The spores germinated readily on potato dextrose agar, and the resulting colonies were white at first but became greenish with white margins. In inoculation experiments under greenhouse conditions with water suspensions of conidia from single ascospore cultures, leaf lesions, identical with those found in nature developed on both the native and the introduced species in from 7 to 21 days after inoculation, and the fungus was re-isolated. Inoculations on wounded stems yielded small brownish to black lesions, which developed for about a month only on *P. tacamahacca* and cottonwood before being delimited by a periderm, whereas those on the Russian and native poplars continued to grow. Inoculations on unwounded stems resulted in the production of cankers at the bases of leaves and surrounding lenticels on the Russian hybrids and the North-west and Saskatchewan poplars only. Inoculum derived from cottonwood produced leaf spots and cankers similar in character to those originating from the Russian poplars.

The presented data are held to exemplify the danger of a native fungus of minor importance with regard to native species becoming an aggressive parasite on new hosts.

TYLER (L. J.), PARKER (K. G.), & PECHUMAN (L. L.). **The relation of *Saperda tridentata* to infection of American Elm by *Ceratostomella ulmi*.**—*Phytopathology*, xxix, 6, pp. 547–549, 1939.

The common elm borer (*Saperda tridentata*), which is very prevalent in the Dutch elm disease (*Ceratostomella ulmi*) [*R.A.M.*, xviii, p. 717 and next abstract] area adjoining New York City [*ibid.*, xv, p. 327], was found in the course of routine isolations covering a period of four years to be frequently carrying the fungus on emergence from infected logs. In greenhouse inoculation experiments through the feeding wounds of the insects on caged two- to four-year-old budded trees of *Ulmus americana*, infection took place in 1 out of 4 in 1936, 1 out of 8 in 1937, and 10 out of 20 in 1938. Inoculation by means of beetles actually carrying *C. ulmi* was slightly more successful than the entirely artificial method of atomizing the wounds, after the removal of the insects, with the spores of the organism.

WALTER (J. M.). **Observations on fructification of *Ceratostomella ulmi* in England.**—*Phytopathology*, xxix, 6, pp. 551–553, 1939.

During the past three years the coremia and perithecia of *Ceratostomella ulmi* were found in abundance under humid conditions in dead, dying, and fallen elm trees [see preceding abstract] and logs in the vicinity of Oxford, England. The fructifications occurred in the galleries

of *Scolytus scolytus* and *S. multistriatus*, on the inner bark surface and between the inner bark flakes, on the outer xylem surface, and on the cut and broken surfaces of infected wood. The mycelial-conidial stage of the fungus was also occasionally observed between the loosening bark and the outer xylem surface. The development of the perithecia ceased during November and was not resumed before the middle of the following March, the earliest dates on which these organs were found with ascospore slime exuding being 15th April, 1936, 9th April, 1937, and 31st March, 1938. Perithecia were commonly most profuse on surfaces that had produced dense stands of coremia two to four weeks earlier, and undoubtedly serve to extend the period of fresh spore supplies to a given bark or wood surface. Coremia were detected once in nature on the outer bark, but perithecia developed on this substratum only on *Ulmus americana* branches in moist chambers.

Hahn (G. G.). Susceptibility of seedlings of *Ribes punctatum*, an Andine Currant, to *Cronartium ribicola*.—*Phytopathology*, xxix, 7, pp. 643–644, 1939.

The author reports the susceptibility of *Ribes punctatum*, a native of the Andes in Chile and the Argentine, to *Cronartium ribicola* [*R.A.M.*, xviii, p. 323] and points out that the species should prove of use as a source of teleutosori inoculum for infection tests in the greenhouse in autumn and winter.

Murrill (W. A.). The cause of pecky Cypress.—*Bull. Torrey bot. Cl.*, lxvi, 2, pp. 87–92, 1939.

In July, 1938, the author noted a cypress (*Taxodium distichum*) tree in Florida bearing a six-years-old bracket of *Fomes geotropus* [*R.A.M.*, xv, pp. 471, 759] on the trunk 3 ft. above the ground. The fungus is regarded as the cause of 'pecky' cypress, used in the United States for antiques and interior finishing. The decay was traced from the hollow base upward to its termination in sound wood, infection having probably occurred at a wound near the base. The formation of a bracket appears to be rare.

Ellis (D. E.). *Ceratostomella ips* associated with *Ips lecontei* in Arizona.—*Phytopathology*, xxix, 6, pp. 556–557, 1939.

The blue-staining fungus, *Ceratostomella ips* [*R.A.M.*, xv, pp. 544, 827; xvii, p. 699; xviii, p. 488], was isolated from 45 out of 54 adult bark beetles (*Ips lecontei*) removed from freshly made galleries in standing *Pinus ponderosa* trees in the Prescott National Forest, Arizona, dipped in 50 per cent. alcohol, and dropped on to malt agar slants in the field. Stained and unstained fragments of wood from the edges of the galleries also consistently yielded the same fungus in culture. This is believed to be the first record both of *C. ips* in the south-west and of its association with *I. lecontei*.

Jørgensen (C. A.), Lund (A.), & Treschow (C.). Undersøgelser over Rodfordærveren, *Fomes annosus* (Fr.) Cke. [Studies on the root-destroyer, *Fomes annosus* (Fr.) Cke.]—*K. VetHøjsk. Aarsskr.*, 1939, pp. 71–128, 8 figs., 1939. [English summary.]

On the basis of a regional survey of Danish forests, the total annual loss due to wood destruction by *Fomes annosus* on Norway spruce

[*Picea abies*], the principal conifer grown in the country, is estimated at Kr. 1,000,000.

No definite correlation could be established between the incidence of heart rot and soil type, though the disease tended to assume a more virulent character on sand than on clay. Sitka spruce [*P. sitchensis*] was found to be the most susceptible host of the fungus, followed by Weymouth pine [*Pinus strobus*], while certain *Abies* spp. and Austrian pine [*P. laricio* var. *nigra*] are highly resistant. An intermediate degree of susceptibility was shown by *P. contorta* and silver fir [*A. alba*], while Douglas fir [*Pseudotsuga taxifolia*], larch, and Scots pine [*Pinus sylvestris*] were fairly resistant. Young trees were uniformly more resistant than old ones, and where the Norway spruce is cultivated on the same area for two or more generations, heart rot generally increases in severity. Heavy thinning is recommended as a means of reducing infection, beginning when the stands attain an age of 20 to 25 years and continuing at bi- to triennial intervals.

On a spruce sawdust medium *F. annosus* grew well at acid reactions (initial P_H 3.9, 4.6, and 6.1, end 4.1, 3.9, and 4.4 after 19 months), but not at 7 or 8 (6.3 and 6.4); in sterilized raw humus the hydrogen-ion concentration was of less importance, good development being secured at a range from 4 to 6.8 (4.8 to 6.3 at the close of the test). On a synthetic nutrient medium asparagin and peptone provided the best sources of nitrogen, while humic acid was the most readily assimilated of the carbons.

Dead roots attached to the trunk bases were found to be the chief sources of infection. In a series of inoculation experiments in which the mycelium of the fungus was introduced into a transverse cut on a damaged tap-root, positive results were obtained in 9 cases out of 14, infection spreading from the dying part of the root through the trunk base to a height of between 30 and 70 cm. in the course of a year.

While judicious thinning is the sole feasible method of control in existing spruce stands, the relative susceptibility of the different conifers to *F. annosus* should be considered in the laying-out of new ones. Rotation with deciduous trees (birch or alder) may be advantageous, or broad-leaved trees may be interplanted with conifers. Sowing is preferable to planting in new cultures. An endeavour should be made to induce a relatively shallow growth habit, with the roots spreading out flat in the uppermost soil layers. Protection may also be afforded by the application of lime, Bordeaux-lime, or insoluble phosphates of alkaline reaction to the soil surrounding the young plants, and experiments along these lines are proposed.

AIROLA (E. V.). **Valmiiden massapaalien höyrysteriloimisen mahdollisuuksista.** [Possibilities of sterilizing pulp bales by the use of steam.]—*Finsk PappTidskr.*, 1939, 7a, pp. 132-136, 2 figs., 1 graph, 1939. [English summary.]

Small bales of chemical and mechanical pulp were subjected to steam of 100° C. for varying periods, the outer portions receiving more intensive treatment than the inner, which, however, retained higher temperatures for a much longer period after the discontinuance of steaming than the outer. Although the temperature in the centre of the bales was

never very high, it was sufficient to kill certain troublesome moulds, e.g., *Pullularia pullulans* [*R.A.M.*, xviii, p. 285] at 47°.

ENGLUND (B.). **Über Pilzschäden in nassem Zellstoff und Holzschliff.** [On fungal damage in wet cellulose and mechanical pulp.]—*Zellstoff u. Papier*, xix, 6, pp. 336, 338, 340, 342, 344, 346, 348, 11 figs., 1939.

This is a comprehensive survey of the problem of fungal infection of pulp [*R.A.M.*, xviii, p. 362] in Finland, among the organisms associated with which are brown rot [unspecified], *Pullularia pullulans*, *Alternaria humicola* [ibid., xvii, pp. 84, 838], and *Rhinocladiella atrovirens* [ibid., xvi, p. 575]. The optimum temperature range for the growth of staining fungi is 20° to 30° C., so that their propagation is practicable in many backwater systems, especially in the summer months. However, the most suitable temperature for manufacturing purposes lies between 35° and 65°, which is beyond the maximum for most of the fungi in question, only two out of 16 being able to withstand a temperature of 50° for 48 hours. Similar results are stated to have been obtained in Norway. Brown rot is exceptional in respect of its temperature relationships, multiplying with great rapidity above 50° and attaining a maximum at 60°, followed by an equally swift decline.

Among the most efficient chemical sterilizers are the chlorophenols dowicide [ibid., xviii, p. 363] and santobrite, and sulphuric acid, the last-named being the most economical, but biological control (by the introduction into the pulp of micro-organisms antagonistic to the pathogens) is considered to afford the best prospect of ultimate success.

RENNERFELT (E.). **Utveckling av svampar i slipmassa av färsk och flottad ved.** [The development of moulds in pulp of fresh and floated wood.]—*Svensk PappTidn.*, xlii, 1, pp. 2-5, 1 graph, 1939.

In laboratory tests to determine the relative susceptibility to fungal infection of floated and green wood (spruce and pine), the development of the yeasts *Rhodotorula glutinis* and *Saccharomyces cerevisiae*, as well as of the 'blueing' organisms, *Cadophora* [*Phialophora*] *fastigiata* [*R.A.M.*, xvii, p. 178] and *Pullularia pullulans* [see preceding abstracts], was much more rapid on the latter than on the former. Moreover, in flasks containing (a) glucose alone and (b) the same with the addition of green wood or an extract therefrom, the fungi grew much more quickly on (b) than on (a). The same applies to boards prepared from green wood, which evidently contains substances favourable to mould growth. The increasingly common practice (in Sweden) of mixing fresh with floated wood is therefore to be deprecated, especially where immediate disposal of the pulp cannot be effected.

SCHULZE (B.) & THEDEN (G.). **Polarisationsmikroskopische Untersuchungen über den Abbau des Werkstoffes Holz durch holzerstörende Pilze.** [Polarization-microscopic studies on the disintegration of timber by wood-destroying fungi.]—*Holz Roh- u. Werkstoff*, i, pp. 548-554, 1938. [Abs. in *Zbl. Bakt.*, Abt. 2, c, 18-23, p. 470, 1939.]

The examination in polarized light of radial, transverse, and tan-

gential sections of wood blocks exposed for definite periods to infection by wood-destroying fungi reveals the progressive disintegration of the cellulose, involving the disappearance of double refraction, while in normal light no significant changes are apparent [cf. *R.A.M.*, xviii, p. 563]. As a rule the advance of the organisms is irregular, severely infected areas alternating at random with completely sound tissues, an observation that explains the prevalent cracking of diseased wood. Early and late wood may be attacked in a different manner by the same fungi, while the latter also vary in their mode of infecting the same wood. *Lentinus squamosus* [*L. lepideus*], for instance, on Scots pine [*Pinus sylvestris*] wood proceeds with great regularity and causes few fissures, whereas *Lenzites abietina* produces intense local infection in some areas and leaves others untouched, leading to extensive cracking.

ALBERTI (K.). **Untersuchungen über das Osmose-Holzschutzverfahren.** [Investigations on the osmosis wood preservation process.]—*Holz Roh- u. Werkstoff*, i, pp. 426–432, 1938. [Abs. in *Zbl. Bakt.*, Abt. 2, c, 18–23, p. 469, 1939.]

Osmolite timber preservatives [cf. *R.A.M.*, xvii, p. 283], consisting of sodium fluoride, dinitrophenol, and arsenic in various proportions, are applied in Germany in paste form at maximum concentrations to newly felled, decorticated logs, which are then stacked in a sheltered place for three to six months. By this time the disinfectant will have penetrated deeply into the wood (heartwood in the case of pine). Osmolite-U and osmolite-U-arsenic form cryolithic compounds in the wood and are thus able to resist lixiviation, to which the ordinary osmolites are liable.

SCHULZE (B.) & THEDEN (G.). **Untersuchungen über die beim 'Klötzchen-verfahren' in der Kolleschalen vorhandenen Feuchtigkeitsverhältnisse.** [Investigations on the moisture relations prevailing in Kolle flasks in the 'wood block process'.]—*Holz Roh- u. Werkstoff*, i, pp. 501–502, 1938. [Abs. in *Zbl. Bakt.*, Abt. 2, c, 18–23, pp. 469–470, 1939.]

It was ascertained by means of hygrometric and electrometric computations that an atmospheric humidity of 100 per cent. prevails in the Kolle flasks used for testing timber preservatives by the wood block method for a period of up to five months. The moisture content of the wood blocks at first increases very rapidly, then somewhat more slowly, reaching fibre saturation point in about five days. The further fungal decomposition is advanced, the higher is the moisture content of the wood up to fibre saturation point, beyond which the attacks of the pathogens are impeded by the water filling the wood pores.

SCHULZE (B.). **Umfassende Prüfung von Holzschutzmitteln gegen holzzerstörende Pilze.** [The comprehensive testing of timber preservatives against wood-destroying fungi.]—*Holz Roh- u. Werkstoff*, ii, 3, pp. 99–109, 10 figs., 4 graphs, 1939.

Full directions are given for the testing of timber preservatives for

their toxicity to wood-destroying fungi by the standardized wood block method, as well as for other requisite properties, such as penetrability, physico-chemical stability, and absence of corrosive and fibre-damaging effects [cf. *R.A.M.*, xviii, p. 364].

OLSSON (P. A.). **Klumprotsjuka (*Plasmodiophora brassicae* Wor.) på Rovor och Kålrötter samt åtgärder mot densamma speciellt ur växtförädlings synpunkt.** [Club root disease (*Plasmodiophora brassicae* Wor.) of Turnips and Swedes with measures for its control, especially from the plant-breeding standpoint.]—*Sverig. Utsädesfören. Tidskr.*, xlix, 1, pp. 4-76, 16 figs., 1 diag., 1939. [English summary.]

This is an exhaustive survey of the available knowledge concerning club root of crucifers (*Plasmodiophora brassicae*), with special reference to its occurrence in Sweden on turnips and swedes and to the possibilities of control by the development of resistant varieties [*R.A.M.*, xviii, p. 720]. Much of the information here presented has already been published in this *Review*, but the following items may be mentioned. There is a certain resemblance between the club root excrescences and those liable to develop, presumably as a sequel to chromosomal aberrations, in hybrids between turnips, and swedes or other crucifers [*ibid.*, xviii, p. 282]; in the latter case, however, there is no tendency to decay. Full details are given of the breeding experiments in progress under the auspices of the Swedish Seed Association since 1929, which have amply demonstrated the difficulties of developing a permanently resistant habit.

No variety of swedes has been found as resistant as May or Immune, though the latter is not really immune and may show up to 50 per cent. of the plants mildly affected. Bortfeld is less resistant than Dale's Hybrid, and Bangholm than the green-topped Swedish type. Neither Herning, a Danish variety, nor Wilhelmsburger (of German origin) seems to be appreciably superior to the common Swedish swede. The turnip Bruce Purple Top (8008) presented a very sound appearance in the field, but only 6 to 7 per cent. of the roots were found to be entirely healthy; however, the high degree of resistance of this variety was demonstrated by the large percentage (up to 83 per cent.) of slightly infected roots.

LE CLERG (E.). **Relative efficiency of quasifactorial and randomized-block designs of experiments concerned with damping-off of Sugar-Beets.**—*Phytopathology*, xxix, 7, pp. 637-641, 1 fig., 1939.

Data obtained from uniformity trials made with sugarbeets against damping-off [*Corticium solani*, *Phoma betae*, and *Pythium de Baryanum*: *R.A.M.*, xvii, p. 153; xviii, p. 536] in the field in two years, and in two trials on two types of plant tables in the greenhouse demonstrated that the quasifactorial design of plot arrangement was more efficient than a randomized block test in some seasons with 36 treatments in the field. With 25 treatments or under, the quasi-factorial design was less efficient in most cases, though more efficient in a few. In the greenhouse tests marked losses in efficiency resulted with the quasi-factorial design as compared with the randomized-block.

DOXTATOR (C. W.). **Results of variety trials by the American Beet Seed Company.**—*Proc. Amer. Soc. Sug. Beet Technol.*, 1939. [Abs. in *Facts ab. Sug.*, xxxiv, 8, p. 35, 1939.]

The yields obtained from eight U.S. sugar beet selections grown in (1) leaf spot [*Cercospora beticola*: *R.A.M.*, xviii, p. 721], (2) non-leaf spot, and (3) curly top [*ibid.*, xviii, p. 287] areas of the United States are tabulated.

DE BRUYN (HELENA L. G.). **Mangaangebreek, oorzaak van de kwade harten van Erwtten.** [Manganese deficiency as the cause of marsh spot of Peas.]—*Tijdschr. PlZiekt.*, xlv, 3, pp. 106–120, 2 pl., 1939. [English summary.]

Further evidence is adduced from experiments with water and glass sand cultures for the implication of manganese deficiency in the etiology of marsh spot of peas in Holland [*R.A.M.*, xviii, p. 79]. In acid solutions the manganese is more readily available to the plants than in alkaline ones, but even in the former the pathological symptoms developed in the absence of sufficient quantities of the element, showing that the hydrogen-ion concentration of the medium is of secondary importance. The seeds in the later formed pods of individual plants were more severely affected than those produced earlier, when the supplies of available manganese are presumably larger. Under field conditions the highest incidence of marsh spot occurs among the heaviest peas, but in cultures the lightest (under 400 mg.) suffered most (41·5 per cent.) and the heaviest (over 500 mg.) least (19·5 per cent.).

DELWICHE (E. J.), MUSBACH (F. L.), SARLES (W. B.), TRUOG (E.), WALKER (J. C.), & WILSON (H. F.). **Canning Peas in Wisconsin.**—*Bull. Wis. agric. Exp. Sta.* 444, 24 pp., 7 figs., 1939.

This bulletin contains the following information on canning pea diseases. Seed-borne diseases, such as the foliage and pod blights caused by *Ascochyta [pisi]*, are diminishing in importance now that nearly all Wisconsin planting stock is procured from the arid western States free from these organisms. For the same reason bacterial blight [*Pseudomonas pisi*] is less troublesome than formerly.

Common wilt [*Fusarium orthoceras* var. *pisi*: *R.A.M.*, xviii, p. 81] may be combated by the cultivation of resistant varieties, e.g., the highly popular Alaska, Wisconsin Early Sweet, New-Line Surprise, and Mardelah (early), Ace, Climax, Canner King, Epicure, Early Kay, Gradah, Pride, Wisconsin Penin, Early Wales, Early Perfectah, and Early Perfection (mid-season), and Yellow Admiral, Green Admiral, Major, Wisconsin Merit, Wilt Resistant Perfection, and Prince of Wales (late). The only variety with a moderately high degree of resistance to 'near wilt' [*F. oxysporum* f. 8: *ibid.*, xiv, p. 613] is Rogers K.

Damage from root rot [*F. solani* var. *martii* f. 2 and *Aphanomyces euteiches*: *ibid.*, xvi, pp. 439, 510] is mainly restricted to rainy seasons and wet soils, for instance, the clays of the east and north-east and the heavy silt loam of the central part of the State. In 1938 drilling fertilizer with the seed substantially reduced the losses from root rot on the last-named soil type, other helpful practices being thorough drainage and tillage before sowing, and crop rotation.

In seed treatment trials [against unspecified rots] in 1936, 1937, and 1938, red copper oxide and cerasan [ibid., xviii, p. 495] were of no benefit during the first two years, but improved the stands of sweet varieties (not Alaska) in the wet season of 1938. Chemical seed treatment has the disadvantage of killing the root nodule bacteria introduced into the seed through inoculation, and is not generally recommended, except possibly for sweet types under damp conditions.

MCKAY (R.). **Observations on Onion mildew caused by the fungus *Peronospora schleideniana* W. G. Sm.**—*J. R. hort. Soc.*, lxiv, '6, pp. 272–285, 7 figs., 1939.

In a study on the onion mildew (*Peronospora schleideniana*) [*R.A.M.*, xviii, p. 728] conducted in the Glasnevin Botanical Gardens, Eire, from 1931 to 1938, the part played by oospores in the perpetuation of the disease was investigated. It was found that in some seasons the oospores are produced in enormous numbers, as many as 90 per cent. of the leaves containing them, and up to 1,176 oospores occurring per sq. mm. of leaf surface. Germination was first observed when the oospores were four years old, and after a further five months reached 1 per cent. in oospores placed in water and kept at room temperature for eleven days. The percentage increased to about 2 per cent. in five-year-old spores [cf. ibid., xvi, p. 651]. At the end of seven years the germination amounted to about 5 per cent. in spores kept in water for 48 hours at 20° C., but increased to 95 per cent. after the addition of a potassium permanganate solution (0.01 to 0.02 per cent.) to the spore suspension on slides. A considerable increase, although not quite as high, resulted from the addition of hydrogen peroxide (10 vols. diluted to 1/100 to 1/200). The absolute minimum and maximum temperatures for germination were not ascertained, but in the presence of potassium permanganate five-year-old oospores germinated at temperatures from 2° to 26° inclusive, with the optimum around 20°. These observations indicate that the oospores remain viable for a long period of time, the exact number of years being still unknown.

It is recommended that wherever onion mildew occurs, all foliage should be raked together and burnt, and on no account added to the manure or the compost heap.

OGILVIE (L.), CROXALL (H. E.), & HICKMAN (C. J.). **Progress report on vegetable diseases. X.**—*Rep. agric. hort. Res. Sta. Bristol*, 1938, pp. 91–97, 1 pl., [1939].

In 1938, asparagus rust (*Puccinia asparagi*) [*R.A.M.*, xvii, p. 716; xviii, p. 649] was not observed until 20th August in the vicinity of Evesham, but by 27th September it had spread considerably in two areas in this locality. No early signs of rust appeared in a field where calcium cyanamide had been applied to the soil at the rate of 5 cwt. per acre after the badly infected bower had been cut, though the disease appeared in a neighbouring two-year-old bed. In October and November the rust was observed to be parasitized by *Darluca filum* [ibid., xviii, p. 580], while *Botrytis cinerea* was frequent on the rust lesions in damp weather, and appeared to check its development in some degree [ibid., xvii, p. 429]. As the uredospores of *P. asparagi* remain viable for

two weeks on cut bower, it should be promptly burned. A small percentage of the teleutospores on old pieces of stem are able to germinate from December onwards, date of germination apparently being related with date of formation and weather conditions during winter. Pycnidia and aecidia were induced to develop on forced asparagus shoots in March by suspending pieces of stem bearing teleutospores over them. The spraying of young beds, which carry over the disease from one season to the next, might, it is thought, prove practicable. Attention is drawn to the importance of cutting the bower low down and destroying old stem bases.

Two further cases of asparagus violet root rot [*Helicobasidium purpureum*: *ibid.*, xiv, p. 730] were observed.

The *Fusarium* [*ibid.*, xiii, p. 668] causing wilt of runner beans [*Phaseolus multiflorus*] has now been identified as *F. vasinfectum* var. *lutulatum* [*ibid.*, xiv, p. 72], and that causing foot rot of leeks as *F. culmorum*, both identifications being made by D. L. G. Davies; a new and severe outbreak of the latter disease occurred in the Fladbury district in July.

Early autumn sowings of onions were more severely affected by white rot (*Sclerotium cepivorum*) [*ibid.*, xviii, p. 82] than were late sowings.

NICOLAS (G.) & AGGÉRY [BERTHE]. **Un Septoria nouveau parasite de la Carotte.** [A new *Septoria* parasitic on Carrot.]—*Bull. Soc. mycol. Fr.*, lv, 1, pp. 118–120, 6 figs., 1939.

In August, 1937, carrots in the vicinity of Pierrefitte (Hautes-Pyrénées) showed the presence of spherical or oval pycnidia measuring 150 to 270 μ in diameter, with a circular ostiole 45 to 60 μ in diameter, on both surfaces of the leaves (which were pale green to greenish brown), leaf sheath, and main stem (on which they were isolated or in groups of two). The pycnidia were lined with short, cylindrical, hyaline sterigmata, 7 to 9 by 3.5 to 4.5 μ , bearing filamentous, rectilinear, or slightly curved spores slender at the extremity, finally bicellular, and measuring 48 to 70 by 3 to 4.5 μ . The intercellular mycelium, 2 to 6 μ in diameter, showed globular, terminal, or intercalary swellings 3 to 7 μ in diameter on a very short stalk, and crowned with a ring of small haustoria. The fungus does not appear to be the same as *Septoria daucina* (the description of which is incomplete, but the spores of which measure 25 to 50 by 1 to 2 μ), and is regarded as a new species, which is named *S. dauci*, with a Latin diagnosis.

FLACHS (K.). **Dactylium dendroides Bull. als Gelegenheitsparasit an Champignon.** [*Dactylium dendroides* Bull. as a facultative parasite of the Mushroom.]—*Prakt. Bl. Pflanzenb.*, xvii, 1–2, pp. 6–12, 6 figs., 1939.

Dactylium dendroides is stated to have been responsible for substantial losses in a Munich mushroom [*Psalliota* spp.: *R.A.M.*, xvii, pp. 584, 791] planting at the end of 1938. On malt agar the conidia germinated readily at room temperature and in a few days produced a yellowish aerial mycelium and a dark red colour and alkaline reaction in the substratum. The fungus grew on weakly acid neutral or weakly alkaline media but not on strongly alkaline ones. The optimum, maximum,

and minimum temperatures for growth were approximately 22°, 29°, and 9° C., respectively. Profuse conidial formation occurred at 18°. A description is given of the characters of the fungus and its taxonomy is briefly discussed. The perfect stage (*Hypomyces rosellus*) did not develop, and inoculation experiments with *D. dendroides* gave negative results.

LINN (M. B.). **Dissemination of Celery blight pathogens on the clothing of farm labourers.**—*Phytopathology*, xxix, 6, pp. 553–554, 1939.

Experimental evidence was obtained in corroboration of field observations on Staten Island, New York, to the effect that the spores of early and late blights of celery (*Cercospora apii* and *Septoria apii*) [*R.A.M.*, xviii, p. 722] are carried on the clothing of labourers engaged in operations necessitating proximity to the beds—in the present instance the cutting of spinach, interplanted in paired rows between the celery and gathered during August when the latter crop is advancing towards maturity. The spinach was cut in the early morning, when the plants were wet with dew.

LIN (K. H.). **The number of spores in a pycnidium of *Septoria apii*.**—*Phytopathology*, xxix, 7, pp. 646–647, 1939.

Examination of 280 samples of celery seed from New York state showed that 142 contained seeds bearing pycnidia of *Septoria apii-graveolentis* [*R.A.M.*, xviii, p. 722]. Counts showed that the number of spores released from one pycnidium amounted to 3,675 (average for nine counts). On severely infected plants an average of 56 pycnidia were present on a lesion. Thus, if only ten primary lesions were present in a seed bed there might be 1,500,000 spores available as secondary inoculum long before transplanting.

MÜLLER (K. O.). **Zur Biologie und Bekämpfung des falschen Mehltaus beim Salat.** [On the biology and control of downy mildew of Lettuce.]—*Kranke Pflanze*, xvi, 6, pp. 110–113, 2 figs., 1939.

Most of the information in this semi-popular note on the biology and control of downy mildew of lettuce (*Bremia lactucae*) [*R.A.M.*, xviii, p. 228] in Germany has already been noticed from other sources [*ibid.*, xviii, p. 7].

PRASAD (N.) & PADWICK (G. W.). **The genus *Fusarium* II. A species of *Fusarium* as a cause of wilt of Gram (*Cicer arietinum* L.).**—*Indian J. agric. Sci.*, ix, 3, pp. 371–380, 1 pl., 1939.

Over 300 isolates of *Fusarium* [*R.A.M.*, xviii, pp. 500, 710] made from wilted plants of gram (*Cicer arietinum*) collected in 1937 and 1938 in Karnal and Delhi, India, were separated into 13 groups according to certain major characteristics. In three lots of infection tests, in which gram seeds were sown in pots with infested sterilized soil, two of the groups appeared to be non-pathogenic, eight caused severe seed rotting, and three caused wilting. On the basis of these results the authors conclude that apart from a wilt of gram due to some physiological disturbance occasioned by soil conditions, as Dastur believed [*ibid.*, xv, p. 423], wilt may certainly be caused by *Fusarium*, as maintained by Narasimhan [*ibid.*, ix, p. 10]. It is also clear that wilted gram plants may harbour an extraordinarily wide range of *Fusarium* types, perhaps

different species, and these are capable of causing two distinct diseases, namely, a seed rot and a wilt. A morphological study of single spore cultures of the three wilt-producing types isolated showed that all three are alike in major characters and belong to the subsection *Orthocera*. Further studies for the identification of these fungi are in progress.

GOTTLIEB (M.) & BUTLER (K. D.). **A *Pythium* root rot of Cucurbits.**—*Phytopathology*, xxix, 7, pp. 624–628, 1 fig., 1939.

Watermelons, Honeydew melons, Quil muskmelons, and Crookneck squash in Arizona were attacked in 1935 and 1936 by a watery root rot which caused heavy losses. The disease was characterized by sudden wilting. The roots of affected plants bore light brown, watery, depressed lesions which ranged in size from 3 mm. in diameter to lesions almost entirely covering the root. In some cases several lesions coalesced to form large, depressed, rotted areas. A few indefinite lesions were observed on the stems, and fruit rot was commonly present. The soil was a poorly drained heavy loam, which remained wet for long periods. Infected material constantly showed the presence of *Pythium aphanidermatum* [*R.A.M.*, xv, p. 587], inoculations with which on watermelons, apples, cantaloupes, carrots, cucumbers, eggplants, grapes, summer squash, sweet potatoes, and tomatoes gave positive results, frequently without wounding. The only cucurbit tested that failed to become infected was *Cucurbita digitata*.

Oospores were produced abundantly both in nature and in culture, but sporangial production was induced only with difficulty. Optimum growth in culture occurred at 37° C., growth being very slight at 45° and nil at 5°. Marked loss in vegetative vigour took place following the original isolations. In 16 months vigour steadily decreased and oogonial formation in culture correspondingly declined, oogonia forming still abundantly, but the number of mature oospores falling considerably. Successive passages of the fungus into Cucurbitaceous fruits increased its vigour, but only temporarily.

POLLACCI (G.), CIFERRI (R.), & GALLOTTI (M.). **Il proteinato di rame per uso agricolo.** [The proteinate of copper for agricultural use.]—*Boll. Soc. ital. Biol. sper.*, xiv, 3, pp. 158–159, 1939.

Attention is drawn to the strong fungicidal efficacy, e.g., in the control of vine downy mildew (*Peronospora*) [*Plasmopara viticola*], of a mixture of lysalbinat and protalbinat of sodium with colloidal copper hydrate, producing the double salts of sodium and copper. The resultant blends are stable, economical, easily prepared, of high penetrative capacity, and able to liberate metallic copper in the colloidal state.

SEELIGER (R.). **Beobachtungen über das Auftreten der Perithezien des echten Mehltaus der Rebe.** [Observations on the development of the perithecia of the true mildew of the Vine.]—*Arb. biol. Anst. (Reichsanst.) Berl.*, xxii, 4, pp. 453–478, 2 diags., 1939.

In 1935 the perithecia of true mildew of the vine (*Uncinula necator*) were found in very large numbers from mid-September onwards on greenhouse vines at the Naumburg (Saale) branch of the Biological

Institute, whereas in 1936 they were produced sparsely on two stocks only. Environmental factors were presumably responsible for the differences in the development of the pathogen in the two seasons. In 1935 the mean local temperatures from April to September and June to September were 3.5° and 4.6° C., respectively, above the normal, and the duration of sunshine during the same periods 102.3 and 106.4 hours, respectively, longer than the average, the corresponding figures for the same periods in 1936 being +0.7° and +1.5° and -93.6 and -24.9 hours, respectively. The adverse temperature and sunshine relations of the latter year were not counterbalanced by the rainfall deficit, precipitation during the two observation periods being -70 and -64.6 mm., respectively, as against -30.4 and -11.5 mm., respectively, in 1935. Moreover, assuming that Laibach's observations on the Erysiphaceae [*R.A.M.*, ix, p. 548] are applicable to *U. necator*, the soil dryness induced by the exceptionally warm and rainless summer of 1934 is likely to have persisted through 1935 and further stimulated perithecial formation.

All the vine varieties tested were more or less liable to infection by true mildew, *Vitis lincecomii* being among the most resistant and the *vinifera* varieties Blue Portuguese, Grey Silvaner, and Blue Trollinger highly susceptible. The fact that perithecial production varied greatly in abundance on vines in different houses or in the several parts of the same house is attributed to ecological divergences in the individual habitat rather than to any inherent tendency on the part of the pathogen to fruit less freely on some varieties than on others, irrespective of the incidence of infection. A distinct correlation was observed between the severity of mildew and perithecial development, average infection ratings of 1.3, 2, 3, 3.9, and 4.3 in the customary 0 to 5 scale corresponding to the production of fructifications on 20, 60, 67, 93, and 100 per cent., respectively, of the total number of stocks. There was also a connexion between earliness of infection and intensity of perithecial formation, very late (1.6), late (2.6), medium (2.9), early (3.1), and very early (3.4) varieties showing 40, 44, 73, 100, and 100 per cent., respectively, of stocks bearing the fruit bodies of the fungus. Generally speaking, therefore, susceptible varieties tend to contract the disease early and resistant ones late.

BILLEAU (A.). Cercetari asupra metodelor de observarea desvoltării oosporilor mildiului. [Research on the methods of observation of the development of oospores of mildew.]—*Anal. Inst. Cerc. agron. Român.*, x (1938), pp. 458-463, 5 figs., 1939.

For studying the germination of the oospores of *Plasmopara viticola* in Rumania. [*R.A.M.*, xviii, p. 232], the author devised an apparatus consisting of two glass funnels connected by a horizontal tube embedded in the soil about 8 to 10 cm. below the surface. Into one was placed a wad of asbestos and then clean sand, on the surface of which was spread crushed leaves bearing oospores, while the other (with the top 2 cm. lower than the first) was filled with rain water. Observations made with this apparatus during the years 1935 to 1937 showed that the oospores were able to germinate on the surface of the sand provided it was almost saturated with water.

WILLIAMS (P. H.), OYLER (ENID), WHITE (H. L.), AINSWORTH (G. C.), & READ (W. H.). **Plant diseases.**—*Rep. exp. Res. Sta. Cheshunt, 1938*, pp. 39–63, 1939.

In investigations at Cheshunt in 1938 [cf. *R.A.M.*, xvii, p. 583] cucumbers were found by P. H. Williams to be affected by foot rot due to *Rhizoctonia* [*Corticium*] *solani*, a new host record for England.

In further investigations into *Verticillium* wilt of chrysanthemums [ibid., xvii, p. 584], Miss Oyler inoculated the stems of four Rose Précoce and four Conqueror plants at soil-level with a pure culture of the fungus. After one month, one plant of Rose Précoce was dead, the lower leaves of the other seven had been killed, and the top ones showed yellow patches. The symptoms were more severe on Rose Précoce than Conqueror. Isolations from the discoloured stems, even from the tips of the shoots, and from the petioles of all four plants of Rose Précoce all gave *Verticillium*. When chrysanthemum plants were inoculated above soil-level with the *Verticillium* from chrysanthemum, *V. albo-atrum* from tomato and rose, and *V. dahliae*, the lower leaves of the plants inoculated with the first-named died after one month, and the top leaves showed yellow blotches. The plants inoculated with *V. albo-atrum* from tomato showed less severe symptoms. Three months after inoculation, the chrysanthemum strain was reisolated from wood along the entire length of the plants and *V. albo-atrum* up to a distance of 5 cm. above the point of inoculation. Attempts to isolate the other two inoculants were unsuccessful. Other inoculations with the chrysanthemum strain gave positive results on potato, *Antirrhinum*, aster [*Callistephus chinensis*], *Solanum capsicastrum*, stock, sweet pea, and tomato.

Isolations from Ophelia rose petals showing brown, necrotic lesions, 2 to 3 mm. in diameter, with a dark margin, the petals being crinkled round the spots, gave pure cultures of *Botrytis cinerea*, the agent of 'petal fire' [ibid., xvii, p. 248]. Experimental inoculations by spraying or dusting with the spores gave positive results on Lady Sylvia, Richmond, Roselandia, and Talisman roses.

Infection of carnations by anther smut [*Ustilago violacea*: ibid., xvi, p. 726] was secured by placing drops of a spore suspension on the surface exposed when 'stopping' first-year plants. Apparently, when a spore falls on the cut ends of stems left when 'stopping', the plant later develops infected shoots on one side and clean ones on the other. Infection was not obtained through unbroken surfaces, the exposed surface of an old plant, or through roots. The disease was virtually eliminated in one nursery by the use of clean cuttings, without soil treatment, though 70 per cent. of the previous crop had been smutted.

G. C. Ainsworth states that tomato mixed-virus streak [ibid., xviii, p. 484] was more prevalent than in any previous year. The potato virus components were all moderately virulent strains of potato virus X. The green fruits generally showed raised markings, whereas the fruit lesions in single-virus streak are depressed.

Winter tomatoes were attacked by fern leaf due to cucumber virus 1 [ibid., xvii, pp. 78, 354]. This virus is rare locally on glasshouse tomatoes, though prevalent on vegetable marrows and outdoor plants.

In one aberrant case of spotted wilt unripe tomatoes showed

conspicuous markings, though the leaf symptoms were very slight, the plants having been 'stopped', probably about the time when infection occurred. In a second case, leaf-bronzing was associated with brown streaks on the stem and leaf stalks, though only the spotted wilt virus was present.

Gladiolus plants were affected by mosaic, probably the same as that observed in America in 1928 [ibid., vii, p. 516].

Exmouth Crimson chrysanthemums showed a green (occasionally yellow) mottle of the upper leaves due to a strain of cucumber virus 1 that caused much greater distortion in *Nicotiana glutinosa* than the type virus. Cucumber virus 1 was also obtained from lupin, asparagus kale [*? Brassica oleracea* var. *botrytis*], and sweet pea, the last two being new hosts for England.

Garden and sweet peas were affected by lettuce mosaic virus [ibid., xviii, p. 649], which produced streak symptoms on the sweet peas.

Enation pea mosaic [ibid., xviii, p. 150] and common pea mosaic [ibid., xvi, p. 583] were frequently observed. In sweet peas the former is characterized by a yellow flecking of the leaves and the presence of enations on the under surfaces of the leaves; similar enations are found on garden pea and broad bean [*Vicia faba*]. Common pea mosaic (a group of diseases caused by strains of one virus) attacks garden pea, sweet pea, broad bean, and red clover [*Trifolium pratense*]. The strain of common pea mosaic usually observed caused a faint mottle in sweet pea leaves and breaking in the coloured flowers.

W. H. Read states that a copper-zinc silicate (25 per cent. copper and 4 per cent. zinc), used at 0.2 per cent. in combination with a petroleum emulsion, gave good control of tomato leaf mould (*Cladosporium fulvum*) without noticeable leaf- or fruit-marking, but on rose leaves caused rather more marking than copper oxychloride-oil emulsion mixture.

HOPKINS (J. C. F.). Report of the Branch of Plant Pathology for the year ending 31st December, 1938.—*Rhod. agric. J.*, xxxvi, 8, pp. 589–597, 1939.

In this report on plant disease work in Southern Rhodesia in 1938 it is stated that the chief apple diseases found locally are mildew [*Podosphaera leucotricha*: *R.A.M.*, xvii, p. 45], fruit cracking (not always associated with *Coniothecium chomatosporum*) [loc. cit.], and canker (*Botryosphaeria ribis* [var.] *chromogena*) [ibid., xvii, p. 755]. The last-named fungus causes extensive damage to avocado and guava trees, and cross-inoculations from apple and avocado branches to apple and avocado fruits gave positive results.

A preliminary survey of fungi causing breakdown in stored apples showed the prevalence of bitter rot (*Glomerella cingulata*) [ibid., xvii, p. 45] and canker rot (*B. ribis* var. *chromogena*), the latter of which produced an unpleasant wet breakdown rendering numerous samples unsaleable. Examination of many apple trees in various districts showed a high percentage of canker on the branches and trunks. Boxes of apples kept in commercial cold storage for six months showed between 25 and 40 per cent. breakdown due to *Penicillium expansum* [ibid., xviii, p. 441].

Tobacco wildfire (*Bacterium tabacum*) [ibid., xviii, p. 483] caused

heavy loss on some farms, but where control measures were promptly applied was kept within bounds. Field spraying from knapsack sprayers, the most convenient form of application so far tested locally, gave very successful results. Outbreaks increased considerably during the year, many being traced to planting on infected 'second-year' land, or to planting in lands adjacent to those which had carried a diseased crop the year before.

Tobacco was also affected by black stem rot, due apparently to *Pythium aphanidermatum* [ibid., xvii, pp. 163, 295], which killed many young plants put out under unfavourable conditions. In a few instances replanting of entire lands became necessary. In seed-beds it caused persistent damping-off in wet weather, which was controlled by sprinkling the affected patches with dry Bordeaux powder or watering them with Cheshunt compound.

New records for the Colony included *Alternaria mali* on apple [ibid., xviii, p. 38], *Phoma destructiva* [ibid., xvii, p. 139; xviii, p. 726] and *A. solani* [ibid., xviii, p. 66] on tomatoes, and *Coniophora cerebella* [*C. puteana*: ibid., xviii, p. 425] causing dry rot of timber.

Botany and plant pathology.—*Rep. Ohio agric. Exp. Sta., 1936-7 (Bull. 592), pp. 34-40, 1938. [Received August, 1939.]*

In this report [cf. *R.A.M.*, xvii, p. 446] H. C. Young and H. F. Winter state that in several years' investigations into apple measles [ibid., xvii, p. 755] grafting and budding from diseased to healthy trees and injections of juice from diseased and healthy trees gave only negative results. In further studies seven series each of four Red Delicious apple trees were grown for two seasons in Shive's complete nutrient R_3S_3 , one-half atmosphere concentration, in purified sand cultures. Series 1 received the nutrient solution, and the other six were given in addition 1 and 2 parts per million of boron, zinc, and manganese, respectively. During the first season the boron series made about twice the growth of the others. After the first 30 days of the second season pimples appeared on those trees which had not received boron, the inner bark showing a necrotic condition typical of measles. When boron was applied to these affected trees recovery resulted.

In extensive spraying tests in a commercial orchard liquid and dry lime-sulphur, and combinations of lime-sulphur, one-half strength, plus 5 lb. of dusting sulphur or wettable sulphurs per 100 gals. of spray gave fair control of cherry leaf spot [*Coccomyces hiemalis*: ibid., xviii, p. 691] only up to harvest time, while Bordeaux mixture (4-6-100) gave excellent control, but caused severe injury and leaf drop. Cupro-K, Grasselli copper oxychloride, and coposil gave nearly perfect control with very little injury, and that only with the first application.

In a comparative spraying test with a cheap home-made wettable sulphur and a more expensive commercial brand against peach scab [*Cladosporium carpophilum*: ibid., xvii, p. 256] and brown rot [*Sclerotinia fructicola*: loc. cit.], the former material consisting of 8 lb. of dusting sulphur, 4 oz. of dried skim milk, and $\frac{1}{2}$ oz. of aresklene [ibid., xviii, p. 440], mixed dry and added to the tank at the rate of 8 lb. per 100 gals. of water (the commercial product being used at the same strength), one application of either material made three weeks after calyx-fall

kept infection (by both diseases) down to an average of 1.5 per cent. on fruits of the Greensboro, Elberta, and Lemon Free varieties. The unsprayed controls averaged 95 per cent. fruit infection. The pre-harvest spray was very important against brown rot, but had no effect on scab.

Perfect control of peach leaf curl [*Taphrina deformans*] resulted when lime-sulphur at the recommended strength was applied by a steam vapour sprayer [ibid., xvii, p. 446], the apparatus also giving better results than the ordinary type of sprayer when used against apple scab [*Venturia inaequalis*] and cherry leaf spot, sulphur and lime combinations with gelatine giving excellent control of all three diseases with this apparatus. Adequate coverage resulted with one-third the usual amount of spray and water, though the saving so effected was offset by the cost of fuel. The future of the steam sprayer depends largely on evolving a machine which will apply the spray more rapidly.

P. E. Tilford and H. C. Young found that asphaltum paint was the best tree wound dressing tested in respect of rate of healing and prevention of rots.

In a test for the control of damping-off [*Pythium de Baryanum*, *Corticium solani*, and other fungi: ibid., xviii, p. 561] of red pine [*Pinus resinosa*] seedlings, Tilford found that plots receiving $\frac{1}{8}$, $\frac{1}{4}$, and $\frac{3}{8}$ oz. of formalin per sq. ft. three days before seeding in 1936 had, respectively, 24.7, 39.3, and 55.3 per cent. more seedlings in 1937 than the control plots. After emergence no serious infection occurred.

A block of Corsican pines [*P. nigra* var. *calabrica*], which had shown severe needle blight (probably due to a species of *Septoria*) [*? acicola*: ibid., xviii, p. 360], was sprayed six times with Bordeaux mixture (4-6-50 and 4-4-50, with casein and Grasselli spreader), Bordeaux spray made from powder, cupro-K with Grasselli spreader, palustrex [ibid., xv, p. 781], and dry lime-sulphur mixtures (4 lb. per 50 gals.) with gelatine and Grasselli spreader. The copper sprays were about equally effective and as a group were slightly better than the lime-sulphur mixtures. The average percentages of infected needles at the end of the season on the lower branches of the copper- and lime-sulphur-sprayed trees were 8.9 and 11.1 per cent., respectively, as compared with 28 per cent. for the unsprayed. Plots given only two applications (in July and August) showed 10 per cent. infection on the lower needles. Infection evidently occurred late in the season.

R. C. Thomas refers to the presence of the bacteriophage in lucerne stands which have run out or seem to be declining, and states that where it occurs nodule formation is greatly reduced or lacking [ibid., xv, p. 659]. Lucerne seeding: three years old or more and new seedlings in old, unproductive fields almost always have the lytic factor present. The association of the bacteriophage with so many cases of lucerne failure would scarcely appear to be merely incidental.

The bacteriophage can be used to identify species of bacterial plant pathogens and to differentiate strains. Using a bacteriophage specific for *Erwinia amylovora*, identifications were made of isolations from pear, apple, mountain ash [*Pyrus* (?) *americana*], *Cotoneaster*, and hawthorn [*Crataegus* sp.]. By using lytic principles specific for two strains of *Aplanobacter stewarti* [ibid., xviii, p. 173] the strains would be rapidly

differentiated. The use of a bacteriophage associated with lucerne failure makes it possible to select commercial cultures [of *Pseudomonas radicumicola*] resistant to the bacteriophage for seed inoculation.

Sixty-first Annual Report of the North Carolina Agricultural Experiment Station for the fiscal year ending June 30, 1938. Progress report for year ending December 1, 1938.—83 pp., 7 figs., 1 graph, 1939.

The following items of phytopathological interest occur in this report. R. F. Poole states that following heavy rains during the early part of the season, black shank of tobacco (*Phytophthora* [*parasitica* var.] *nicotianae* [*R.A.M.*, xvi, p. 841]) assumed a severe form over a wide area of Forsyth county in 1938. The residual effects of sulphur on the control of the disease were much less pronounced in 1938 than in 1937, under 10 per cent. of the plants receiving up to 800 lb. per acre reaching maturity.

In a test in February, 1937, the losses from *Bacterium solanacearum* in tobacco plots treated with 800, 1,000, and 1,500 lb. each of sulphur and lime were 26.6, 11.3, and 0 per cent., respectively, but the plants receiving the maximum quantity were badly stunted. In order to overcome the nitrogen deficiency liable to develop on soils given the combined lime and sulphur treatment, cottonseed meal was applied to the soil in April at 500 and 1,000 lb. per acre with beneficial results. In plots treated with copper sulphate at 500 and 1,000 lb. per acre the losses from *Bact. solanacearum* amounted to 69.9 and 21.6 per cent., respectively.

The tobacco mosaic virus was found by S. G. Lehman to be more rapidly inactivated in acid than in alkaline soils, while high soil temperatures also accelerate the process.

The same author enumerates the following as the most frequent seed-borne pathogens of cotton: *Glomerella gossypii*, *Fusarium moniliforme* [*Gibberella fujikuroi*: *ibid.*, xviii, p. 520], *F. sp.*, *Pythium*, and *Rhizoctonia* [*Corticium solani*], the two first-named predominating on seedlings from untreated seed not over one year old, the two last on those from treated or older seed, and *F. sp.* being common on both. Of the various chemicals tested for the control of seed-borne fungi, new improved ceresan was the most effective, while promising results were also given by ceresan, cuprocide [*ibid.*, xviii, p. 440], barbak C, sanoseed [*ibid.*, xvii, p. 378], and sterocide; in one experiment the increases from seed treatment with ceresan and sanoseed were 45.8 and 39.8 per cent., respectively. Ceresan also proved very efficacious in the control of sore shin [*C. solani*], which was more prevalent on one-year-old than on two-year-old seed. The same preparation greatly reduced the incidence of *Bact. malvacearum* on the cotyledons.

In an experiment conducted by P. H. Kime and O. P. Owens on Norfolk sand in Richmond county, muriate of potash was applied at the rate of 800 lb. per acre of 6-8-0, 6-8-4, and 6-8-8 for the control of cotton wilt (*F.*) [*vasinfectum*: *ibid.*, xviii, p. 452], which had been present in the soil for several years. Of the twelve varieties included in the test, only Sea Island 13B3 showed no infection, other reputedly resistant types contracting from 13 to 35 per cent. wilt, while two susceptible ones developed 76 and 78 per cent. In the absence of potash even highly resistant varieties were considerably affected.

In inoculation tests by R. F. Poole on sterilized shelled groundnuts with various fungi isolated from root-rotted groundnut plants, *F. vasinfectum*, *G. fujikuroi*, and a number of unidentified *F. spp.* were parasitic to the nuts and other parts of the seedling plants under favourable conditions. *Sclerotium bataticola* [*Macrophomina phaseoli*] was pathogenic at 28° C., but not at 18°; one strain of *C. vagum* [*C. solani*] attacked the nuts at 28° only, another at and below 18°, while *S. rolfsii* [ibid., xv, p. 278], isolated from a single source, is probably perpetuated more extensively through the soil than by way of the seed.

Promising results in the control of *Bact. pruni* on peach were obtained in R. F. Poole's experiments in the heavy application (1,400 to 2,000 lb. per acre) of combined potassium and magnesium sulphates.

R. Schmidt's investigations on the development of tomatoes for resistance to wilt [*F. bulbigenum* var. *lycopersici*: ibid., xviii, p. 766] have conclusively demonstrated the value of Louisiana Pink [ibid., xviii, p. 439] in this respect, while Scarlet Dawn is susceptible.

Plant Pathology Department.—*Rep. Fla agric. Exp. Sta., 1937-38*, pp. 109-128, 3 figs. [1939].

This report contains, among others, the following items of interest [cf. *R.A.M.*, xv, p. 780]. Studies by A. H. Eddins showed that three seed stocks of Irish potatoes showing, respectively, a trace, 5 per cent., and 28 per cent. plants affected with bacterial wilt and soft rot [*Bacterium sepedonicum*: ibid., xviii, p. 758] in Maine fields developed, respectively, 12.2, 25, and 63.9 per cent. diseased plants when planted at Hastings, Florida. Seed pieces from diseased tubers decayed completely or gave wilted plants and infected tubers. Seed pieces cut from healthy tubers with a knife previously used to cut affected ones gave plants 70 per cent. of which bore diseased tubers.

When one lot of Spaulding Rose potatoes of which 37 per cent. showed net necrosis [ibid., xviii, p. 409] was divided into affected and unaffected tubers, the latter gave 44.7 per cent. and the former 84.2 per cent. leaf roll plants, with 40 per cent. less yield from the affected than from the unaffected tubers.

Chippewa potatoes grown in Scranton fine sand treated with 800 lb. sulphur and 3,000 lb. limestone per acre in 1934 showed only 0.05 per cent. brown rot (*Bact. solanacearum*) [ibid., xviii, p. 473] in 1938, as against 1.5 per cent. infection in adjacent untreated plots. The treatment increased the yield by 5.6 barrels per acre. Similar treatment of Bladen fine sandy loam in 1935 also gave excellent control in 1938, with only 0.2 per cent. tubers affected (Spaulding Rose variety), as against 25.4 per cent. in the adjacent controls, and an increased yield of 27.1 barrels per acre. In soils of P_H 5, 5.5, 6, 6.5, the amounts of sulphur required to effect control are 650, 900, 1,150, and 1,400 lb. per acre, respectively. The best control and yield were obtained when 1 ton of limestone per acre was applied five months after the sulphur.

A comparative study by R. K. Voorhees of strains of *Diplodia* resembling *D. frumenti* [ibid., xvii, p. 670] on maize and obtained from various economic hosts in Florida and other tropical regions showed them to be physiologic forms of one species, such species as *D. frumenti*,

D. natalensis, *D. tubericola*, *D. cacaoicola*, *Botryodiplodia theobromae*, and others all being thought to be synonymous.

In tests by A. S. Rhoads *Clitocybe tabescens* [ibid., xiv, 564] grew at all temperatures between 12.3° and 35.8° C., but not at 40.1°; it made best and about equally good growth at 24.7°, 29°, and 31.6°. *Armillaria mellea* made best growth at 21.7° and 24.7° and very slight growth at 35.8°. *C. tabescens* made about equally good growth on potato dextrose maltose agar at all P_H values tested from 3.9 to 8.7, except that on the alkaline side of the range less sporophore development occurred. *A. mellea* grew equally well at all reactions from P_H 3.9 through 6.3, but produced a progressively decreasing amount of growth beginning with P_H 7.0. Artificial infection of two large Australian pines (*Casuarina lepidophloia*) was obtained with *Clitocybe tabescens* by wiring pieces of infected roots of *Casuarina equisetifolia* in contact with uninjured roots. This is the first occasion that this disease has been transmitted artificially from affected to healthy trees. During the year *Clitocybe tabescens* were isolated from three new hosts, making a total of 139 different species found infected in Florida.

A. N. Brooks found that during winter and early spring mature ascospores of celery pink rot (*Sclerotinia sclerotiorum*) [ibid., xv, p. 768; xvii, p. 588] remained viable *in vitro* and under different light intensities for 20 to 63 days. Inoculation tests indicated that the ascospores are unable to infect uninjured tissue. Deep ploughing, by burying most of the sclerotia, greatly reduces the number of apothecia developing in the field during the growing period of the crop, while flooding kills the sclerotia. In field treatments the only plots not showing apothecia were those given calcium cyanamide applied dry at rates of 2,000, 4,000, and 8,000 lb. per acre after harvest. These plots at first remained healthy, but infection gradually spread to them from the others, and at harvest time they showed as much disease as the untreated controls.

A. S. Rhoads states that in May, 1935, patches of bark from an orange limb affected by psorosis [ibid., xviii, p. 518] were grafted into the upper limbs of five large healthy orange trees, and in June, 1938, six inoculated limbs on three trees had developed symptoms varying from initial scaling of the bark to well-defined lesions. This indicates that the disease belongs to the virus group.

GRIEVE (B. J.). **Epinastic response induced in plants by *Bacterium solanacearum* E.F.S.**—*Ann. Bot., Lond.*, N.S., iii, 11, pp. 587–600, 1 pl., 1 fig., 1939.

In further studies carried out in Melbourne evidence was obtained that the epinastic response in leaves of potato, tomato, castor oil (*Ricinus communis*), and African marigold (*Tagetes erecta*) plants invaded by *Bacterium solanacearum* [*R.A.M.* xvii, p. 302] is an irreversible growth reaction. No constant relation was established between the number of bacteria present at or near the reactive zone or the degree of penetration into the leaf trace bundle and the initiation of the condition. The growth reaction was governed by the plant variety, size of the plant, environmental conditions, and relation of the plant to gravity. No evidence was forthcoming that bacterially induced

epinasty in potato plants is rendered less effective by the neutralization or co-operation of gravity, whereas inverted tomato plants showed no such epinastic reaction. Proof was obtained that epinastic response is not due to mechanical blocking of the vessels by bacteria, ammonia production and P_H effects in the vessels, or toxin production. Hetero-auxin is produced in culture media in amounts sufficient to induce epinasty in tomato leaves, but so far it has not been detected in invaded vessels.

NÁBĚLEK (V.). **Apfelduft fördert Pflanzenkrebs.** [Apple aroma promotes crown gall of plants.]—*Z. Krebsforsch.*, xlviii, 5, pp. 391–399, 8 figs., 1939.

In experiments at the Pressburg (Bratislava) Biological Institute, Czechoslovakia, in which sunflower seedlings inoculated with *Bac[terium] tumefaciens* were grown under bell-jars in the presence of a fresh green Jonathan apple, the aroma emanating from the fruit immediately arrested the ontogenetic growth of the plants while simultaneously stimulating that of the bacterial tumours to dimensions eight to ten times exceeding those on similarly infected seedlings without apples. It is apparent from their divergent responses to the same stimulus that autonomous crown gall development and normal individual growth are of a fundamentally different order.

ABE (T.) & MATSUMURA (S.). **On the susceptibility of back-crossed offspring of pentaploid Wheat hybrids to *Puccinia triticina*.**—*Proc. Soc. Crop Sci. Japan*, x, pp. 71–84, 1938. [Japanese. Abs. in *Jap. J. Bot.*, ix, 4, pp. (145)–(146), 1939.]

The authors describe their observations in Japan on the reaction of the back-crossed progeny of pentaploid wheat hybrids to *Puccinia triticina* [*R.A.M.*, xvi, p. 238], which showed that in 1936 *Triticum polonicum* var. *vestita* and *T. durum* var. *reichenbachii* (both representatives of the emmer group, $2n = 28$) suffered little or no damage in the field from the disease, whereas the dinkel (common) *T. vulgare* var. *erythrospermum* and *T. spelta* var. *duhamelianum* ($2n = 44$) were severely attacked. The reciprocal F_1 hybrids between (1) *T. polonicum* var. *vestita* and *T. spelta* var. *duhamelianum* and (2) *T. durum* var. *reichenbachii* and *T. vulgare* var. *erythrospermum* proved to be fairly susceptible to the rust, resembling in this respect the common rather than the emmer parents. In 1937 inoculation experiments on the back-crossed seedlings *T. polonicum* var. *vestita* $\times F_1$ and *T. durum* var. *reichenbachii* $\times F_1$ and reciprocally ($2n = 28$ to 35) substantiated the connexion between a high chromosome number and susceptibility to *P. triticina*, the correlation coefficient being $r = +0.4021 \pm 0.0504$. In all cases the increase in the chromosome number originated in the D-genom derived from common wheat, which is evidently the chief, though probably not the sole, carrier of susceptibility. On the other hand, there was no marked increase in the susceptibility of the back crosses *T. vulgare* var. *erythrospermum* $\times F_1$ and *T. spelta* var. *duhamelianum* $\times F_1$ and reciprocally, which are similarly liable to the rust, parallel with an increase in the chromosome number ($r = +0.651 \pm 0.0467$).

PARKER-RHODES (A. F.). **Investigations on certain toxic substances obtained from the Wheat plant which inhibit the germination of the uredospores of various Wheat rusts.**—*J. agric. Sci.*, xxix, 3, pp. 399–417, 6 graphs, 1939.

Substances capable of inhibiting or reducing the germination of the uredospores of *Puccinia glumarum* and *P. triticina* were obtained from wheat plants by grinding up healthy leaves with water, boiling the pulp for a few minutes, centrifuging at about 1,000 r.p.m. for a few minutes, and then decanting the clear green supernatant solution. Plants of Little Joss lost their resistance to *P. triticina* when infected with *Tilletia caries*, and a solution from such plants was less toxic to the rust than that from healthy ones of the same variety. On the other hand, healthy plants of the variety Vulgare P.P. yielded a more toxic solution than Kanred, though the latter is more resistant, and no correlation was observed in four other varieties of wheat tested. When, however, the solutions were prepared by a method reducing enzyme activity during preparation to a minimum (namely, from leaves dried in an oven at 95° C., water being added at the rate of 40·5 parts by weight to one part of dry leaf tissue), it was found that these were non-toxic when obtained from healthy living leaves, possibly toxic when derived from decaying ones, and toxic when originating in rusted material. In the last case a greater toxin production was observed in plants supplied with excess of potassium or those deficient in boron, copper, zinc, and manganese. Toxic substances produced in leaves infected with *P. glumarum* were toxic only to spores of that species and not to those of *P. triticina*, and vice versa. It is suggested that these specific toxins are either antibodies analogous to those known from animal pathology, normal constituents of the rust hyphae, or staling products, and that they are distinct from the non-specific toxins obtained by the method first described from triturated healthy or decayed leaves, which may possibly be the product of the autolytic activity of enzymes.

MILLIKAN (C. R.). **The influence of nutrition on the reaction of Wheat to *Urocystis tritici* Koern.**—*J. Dep. Agric. Vict.*, xxxvii, 6, pp. 302–308, 1 fig., 1 graph, 1939.

In sand culture trials conducted at Burnley, Victoria, in 1936, calcium deficiency was found to inhibit completely the development of flag smut (*Urocystis tritici*) [*R.A.M.*, xviii, p. 656] in the susceptible Free Gallipoli wheat variety, nitrogen and potassium deficiencies both tended to decrease the severity of the disease, and phosphorus and magnesium deficiencies to increase it. In experiments on the same variety in 1937 confirmation was obtained of the effects of deficiencies of calcium, potassium, magnesium, and phosphorus, though calcium deficiency permitted some infection; the increase resulting from phosphorus deficiency was very significant, whilst nitrogen deficiency was not tested, and calcium excess increased infection. In tests in 1937 with the resistant variety Ghurka excess calcium again increased infection, but the results with deficiencies of calcium, phosphorus, potassium, and magnesium were not significant. In 1938 further

confirmatory evidence of the effect of calcium deficiency and excess in reducing and increasing the severity of flag smut was obtained on Free Gallipoli. The results of chemical analyses of the experimental plants of this variety showed that an optimum concentration of calcium for the development of flag smut obtains, above and below which the severity of infection increased. In the Ghurka variety the relationship was less clearly defined. No relationship was detected with the other constituents.

RUSSELL (R. C.). **Pathogenicity tests with cultures of *Ophiobolus graminis* Sacc.**—*Sci. Agric.*, xix, 11, pp. 662–669, 1 fig., 1 graph, 1939.

Further tests (carried out from 1937 to 1939) are described on the relative pathogenicity to wheat of eight isolates of *Ophiobolus graminis* used in similar experiments in 1934 [*R.A.M.*, xiii, p. 502]. Of these, five from Saskatchewan had been growing in culture for 9 to 14 years (by 1939), while one from Australia and two from the United States had probably been kept in pure culture for over 15 years. Wheat seedlings in sterilized soil in crocks in the greenhouse were inoculated and a disease rating was arrived at based on the amount of stunting and lesions produced. The results showed that the pathogenicity of most of the isolates continued to fluctuate since 1934. For instance, isolate 1 was moderately pathogenic in 1934, only slightly so in 1937, 1938, and January, 1939, and moderately so again in March, 1939. During the same period the pathogenicity of isolate 2 fell from severe to slight and rose again to moderate. The pathogenicity of isolate 3 remained slight, whereas that of isolate 4 fell from severe to slight. Isolate 6 was slightly pathogenic in 1934, moderately so in 1937, severely so in 1938, and again moderately pathogenic in 1939. Isolates 10, 11, and 31 all fluctuated, but were all moderately pathogenic in 1939, after over 15 years in culture.

In experiments with isolates 2 and 4 to elucidate the reason for the fluctuations in pathogenicity, neither differences in temperature nor repeated passage through the host exercised any consistent effect on the pathogenicity of either. Cultures of isolate 4 uniformly showed a reduction in pathogenicity since 1936, although kept under different environmental conditions. It would appear that the loss in pathogenicity shown by various cultures of *O. graminis* after long periods in artificial culture was due to some factor operating independently of temperature and unaffected by repeated passages of the culture through the host.

OORT (A. J. P.). **Inoculation experiments with loose smuts of Wheat and Barley (*Ustilago tritici* and *U. nuda*).**—*Phytopathology*, xxix, 8, pp. 717–728, 2 figs., 2 graphs, 1939.

A full description is given of the author's experiments at the Mycological Laboratory, Wageningen, Holland, in the inoculation of Vilmorin 27 wheat and Vogel's Agaer and Vindicat 14 barley with loose smuts (*Ustilago tritici* and *U. nuda*, respectively), using an adaptation of M. B. Moore's technique [*R.A.M.*, xv, p. 567] involving the enclosure in the inoculating chamber of four heads instead of one. By this means, two persons can deal in one hour with 80 wheat and 50 barley heads,

representing a substantial increase over the numbers that can be treated in a corresponding period by the Halle method, entailing the inoculation of each individual flower with dry spores, as described by Roemer *et al.* [*ibid.*, xvii, p. 476].

The loss of inoculated plants at emergence and during the winter was relatively slight, amounting to only 10 and under 20 per cent. for wheat and barley, respectively. In all the tests partially diseased plants were observed (3.9 per cent. wheat and 3.8 barley), the majority being more than half infected. In wheat healthy and entirely diseased heads developed in the same plant, whereas in barley semi-infected heads were more prevalent. The optimum period for inoculation lasts only a few days during antithesis. The spore inoculum exerts its maximum effect on wheat and barley at concentrations of 1 and 0.1 gm. per l. water, respectively, but a fairly high degree of infection is obtainable at 0.001 gm. per l. (10 spores per cu. mm.). By increasing the number of vacuum pump strokes, whereby the air between the glumes is replaced by a spore suspension, from two to ten, the incidence of infection by *U. tritici* on wheat was increased from 55 to 83 per cent.

FORBES (I. L.). **Factors affecting the development of *Puccinia coronata* in Louisiana.**—*Phytopathology*, xxix, 8, pp. 659–684, 1939.

In laboratory experiments uredospores of crown rust of oats (*Puccinia coronata*) stored at -18° and 33° C. rapidly lost their germinability, which also did not persist for any length of time at 4° , 15° , and 20° , whereas at 10° 8 per cent. germination was obtained after 413 days. Uredospores exposed to summer field conditions at Baton Rouge, Louisiana, failed to germinate after 75 days. Neither self-sown oats nor wild grasses were found in the neighbourhood during the three months from 1st July to 1st October, 1933. Oats were planted locally on 12th October, 1932, and 10th October, 1933, but the first rust found in the 1932–3 season was on 6th February, 1933, the corresponding date for 1933–4 being towards the end of December, 1933. It is inferred from this circumstantial evidence that the inoculum was not present at Baton Rouge during October, November, or early December in either year.

The minimum, optimum, and maximum temperatures for the germination of crown rust uredospores were found to be just above freezing point, 15° to 20° , and slightly below 35° , respectively [*R.A.M.*, xvii, pp. 233, 437; xviii, pp. 306, 389]. The disease developed on plants incubated at 0° to 2° and post-incubated at 20° , but not on those incubated at 10° or 20° and post-incubated at 0° to 2° . The rust presumably gains ingress to the host at very low temperatures, but is prevented from forming uredosori.

Uredospore germ-tubes of *P. coronata*, *P. graminis avenae*, *P. g. tritici*, and *P. triticina* reacted negatively to white, blue, and green light [*ibid.*, xi, p. 563]. In violet light a tendency to negative phototropism was sometimes displayed by all the rusts except *P. g. tritici*, while *P. triticina* behaved similarly under the influence of red light. It is concluded that the blue, and to a lesser extent the violet, rays are responsible for the negatively phototropic reaction of the germ-tubes to white light. The germ-tubes of *P. coronata* appear to enter the host

without difficulty either in light or darkness. Absence of light during the incubation period increased the percentage of severely infected Gopher oats from 57.3 to 62.4 and that of lightly attacked Victory from 12.8 to 33.3.

Fairly abundant uredospore germination of *P. coronata* took place throughout a P_H range of 4.4 (27.6 per cent. germination) to 7.6 (25.7); the minimum, optimum, and maximum hydrogen-ion concentrations for the germination of the rust are about P_H 2.7, 6.7, and 9.2, respectively.

In three years' field trials at St. Paul, Minnesota, and Baton Rouge on some 100 varieties of oats, the most highly resistant was Victoria; Bond was immune in Louisiana in 1933 and 1934, possibly owing to the absence of the physiologic races 33 and 34, to which this variety is susceptible [cf. *ibid.*, ix, p. 771; xiii, p. 156; xv, p. 571; xviii, p. 242]. A 10 per cent. extract of juice from Victoria and Bond reduced the percentage of germ-tube germination after $3\frac{1}{2}$ hours from 48 to 38 and 31.8 per cent., respectively, the corresponding figures for the 28 per cent. concentration being from 46.85 to 8.80 and 12.66, respectively.

MULLER (H. R. A.). **Overzicht van de belangrijkste Citrus-ziekten in Nederlandsch-Indië.** [A survey of the most important Citrus diseases in the Dutch East Indies.]—*Meded. alg. Proefst. Landb., Batavia*, 34, 42 pp., 29 figs., 1939. [English summary.]

This is a comprehensive survey of citrus diseases in the Dutch East Indies, embodying, in addition to information already available, certain new items of interest based on the author's personal observations. The following diseases are enumerated: damping-off of seedlings (*Rhizoctonia* [*Corticium*] *solani*); *Fusarium* root rot of young plants; fungal root rots (*Armillaria* sp., *Rosellinia arcuata*, *R. bunodes*, *Fomes noxius*, and *F. lignosus*); root rot caused by defective soil aeration; wet and dry bark rots due to *Diplodia natalensis*; bark disease (*Dothiorella* [*Botryosphaeria*] *ribis*) [*R.A.M.*, xvii, p. 162]; another form of bark rot produced by *Nectria haematococca* [loc. cit.]; gummosis (*Phytophthora parasitica*) [*ibid.*, xiv, p. 301]; 'foam' disease [*ibid.*, x, p. 299]; pink disease (*Corticium salmonicolor*); sun scorch of the bark; *Colletotrichum gloeosporioides* associated with die-back of young trees, wither-tip, leaf blights (in conjunction with *Gloeosporium limetticolum*), and fruit anthracnose; canker (*Phytomonas* [*Pseudomonas*] *citri*); scab (*Sphaceloma fawcettii* [*Elsinoe fawcettii*]) [*ibid.*, xiv, p. 742]; exanthema; chloroses; mildew (*Oidium tingitaninum*) [*ibid.*, xvii, p. 162]; sooty mould (*Capnodium* sp.); fruit rots (*Phoma citricarpa* [*ibid.*, xviii, p. 671], *Nematospora coryli* [*ibid.*, xvii, p. 162], and *Oospora citri-aurantii* [*ibid.*, xviii, p. 390]); and oleocellosis.

Corticium solani was held in check by weekly applications to the seed-beds of 1.5 per cent. Bordeaux mixture, while soil treatments before sowing with 0.02 per cent. ceresan or 0.05 per cent. terbolan [*ibid.*, xviii, p. 554] were also effective.

The species of *Armillaria* responsible for severe damage in the Malang district of Java from 1934 to 1938 could not be determined with certainty in the absence of fruit bodies. Ten per cent. of the 100,000 affected trees were killed. Good control was effected by excision of

the diseased roots and the application to the remainder of 1.5 to 3 kg. per tree sulphurous volcanic ash containing 60 to 70 per cent. free sulphur, the same quantity being worked into the surrounding soil. The *Rosellinia* root rots were controlled by the same means.

Diplodia natalensis attacks the bark in two ways, one accompanied by profuse gumming, followed by progressive scaling-off of the upper tissue layers until the cambium becomes involved and large patches of the cortex are killed, the fungus ultimately girdling the whole trunk or main branches. Pomelos, oranges, and Ponderosa and Villa Franca lemons are liable to this type of infection. The other form of bark rot, which is dry and relatively inconspicuous, chiefly attacks oranges of the *Citrus nobilis* (mandarin) group and the thicker limbs of pomelo as a sequel to severe scale (*Asterolecanium*) infestation. The spore masses of the fungus protrude through small cortical fissures. Both forms of the disorder may be combated by the excision of the infected tissues and the application to the wounds of a mixture of carbolineum plan-tarium (92 per cent.) and paraffin (8 per cent.).

Nectria haematococca, one of the principal agents of the death of whole trees or main branches of tangerines in the Batavia district of Java, causes a wet rot of the bark, which becomes covered with the mycelium and spores of the *Fusarium* stage of the fungus; so far control measures have proved ineffectual.

'Foam' disease of mandarin oranges occurs in inadequately irrigated groves in very dry climates. A mixture of the bacteria and yeasts isolated from the malodorous exudate on the bark of affected trees induced the typical symptoms of the disturbance in inoculation experiments, whereas negative results were given by pure cultures of the several organisms. The rot frequently originates at the feeding sites of the beetle *Xylotrupes gideon*, which is probably instrumental in the spread of infection. The application to the invaded areas of lime-sulphur or coal tar gave fairly good control.

Phosphorus deficiency appears to be an important factor in the development of withertip of tangerine twigs and anthracnose of Valencia Late oranges, due in both cases to *Colletotrichum gloeosporioides*.

Oidium tingtonianum may be effectively combated in the plains (below 400 m. above sea-level) by dusting with sulphur, but at higher elevations the use of lime-sulphur (1 in 30) is preferable. Good results have also been obtained with 1 per cent. solbar or mil-du-spra.

P. citricarpa may cause appreciable damage in the pomelo-growing district of Batavia. In fruits still on the trees the necrosis remains confined to the upper layers of the peel, but after picking the peel and pulp are rapidly penetrated, so that an extensive transit rot ensues.

Nematospora coryli was found to be transmitted by the bugs *Rhynchoris serratus*, *Leptoglossus membranaceus*, and *Cappaea taprobanensis*. Even after only one feeding on diseased fruits immediately following hatching, most of the larvae of *R. serratus* and *C. taprobanensis* retain their infective capacity throughout life, irrespective of successive moultings. It is therefore conjectured, though not definitely known, that the fungus is harboured in the intestines of the insects. *R. serratus*, fed once on diseased fruits and daily thereafter on healthy ones, was still

infective after 65 days. *L. membranaceus* also conveyed *N. coryli* to tomato and *Cyphomandra betacea* fruits both in laboratory and field tests.

Oospora citri-aurantii was experimentally shown to be transmissible by the borer moth *Ophideres fullonica* [*Othreis fullonia*].

[This paper also appears as *Meded. Inst. PlZiekt.*, Buitenzorg, 94, 1939, and in *Landbouw*, xv, 5, 1939.]

CROUS (P. A.). **The treatment of sooty blotch on Citrus fruits.**—*Citrus Grower*, 1939, 67, pp. 9, 11–13, 1939. [Abs. in *Chem. Abstr.*, xxxiii, 16, p. 6513, 1939.]

A description is given of the method and apparatus used [in South Africa] for the bleaching of citrus fruits infected with sooty blotch [*Gloeodes pomigena*] in a eusol solution, consisting of $\frac{1}{4}$ lb. each of chloride of lime and boric acid in 1 gal. water [*R.A.M.*, xiv, p. 754].

RAYNER (M. C[HEVELEY]). **The mycorrhizal habit in crop plants, with a reference to Cotton.**—*Emp. Cott. Gr. Rev.*, xvi, 3, pp. 171–179, 1939.

The author records the constant occurrence of the vesicular-arbuscular type of endotrophic mycorrhiza [*Rhizophagus*: *R.A.M.*, xviii, pp. 470, 701] in young plants of Cambodia and Malvi cotton from Indore, India, the infection of the young roots being detected by the increased diameter and greater opacity of the tissues. The incidence and character of infection was observed to vary widely in specimens from the same soil with different manurial treatments. Differential behaviour on the part of the endophyte was particularly well-marked in respect to applications of inorganic as compared with organic manures, and response was also apparent after applications of different kinds of organic manures. Coincidence of vigorous growth of the host with maximum infection may be observed in cotton, and, taken with the histological evidence, this indicates a substantial nutritional balance in favour of the vascular partner.

The author considers that variations in mycorrhizal response can be used as an index of health and growth, but does not suggest that some degree of mycotrophy is necessary for complete nutrition. Her view is rather that for species growing in nature the mycorrhizal condition in a healthy plant expresses a state of physiological equilibrium.

SABET (Y.). **Cotton mycorrhiza.**—*Nature, Lond.*, cxliv, 3635, p. 37, 1939.

The author records the occurrence in Egypt of the typical vesicular-arbuscular endophyte (*Rhizophagus* sp.) within the cortical tissues of cotton [see preceding abstract]. Penetration occurred through the piliferous layer.

KNIGHT (R. L.) & CLOUSTON (T. W.). **The genetics of blackarm resistance. I. Factors B₁ and B₂.**—*J. Genet.*, xxxviii, 1–2, pp. 133–159, 4 pl., 1939.

In a search for varieties of cotton resistant to blackarm (*Bacterium malvacearum*) [*R.A.M.*, xviii, p. 573] large populations of Sakel (a variety of *Gossypium barbadense*) were tested in the Sudan (taking leaf

resistance as a primary basis for selection), but all were found to be equally susceptible. Varying degrees of resistance were present, however, in American Upland strains, and complete immunity in several, though not all, of the Old World types. The genetics of blackarm resistance was studied in crosses between Nye's Uganda B 31, a resistant American Upland strain, and two strains of Sudan-bred Sakel, X 1530 and NT 2, infection being ensured by spraying each plant under test twice daily on three successive days with a suspension of *Bact. malvacearum*. The F_1 generation of B 31 crossed with either of the two Sakel strains was almost as resistant as B 31. The first Sakel back-cross gave a 1:3 ratio of fully susceptible plants to others showing varying degrees of resistance. Plants showing resistance were further back-crossed to Sakel, a 1:3 ratio being obtained in the second and third back-crosses and also a 1:1 in some families of the third. The F_2 of B 31 crossed with either of the two Sakel strains gave a 1:15 ratio of fully susceptible plants to others of varying degrees of resistance, and the first, second, and third back-crosses gave either 1:15 or 1:3 ratios according to the resistance of the parents.

It is concluded from these results that the blackarm resistance of Uganda B 31 is dependent on two major factors, tentatively named B_1 and B_2 , which are dominant and cumulative, and each capable of giving a typical form of resistance when added to the Sakel genotype. These factors impart a greater resistance to the Uganda B 31 genotype than to the Sakel, a difference attributed to modifying factors associated with Uganda B 31. Leaf and stem resistance of the hybrids were found to be positively correlated.

STEYAERT (R. L.). **La sélection du Cotonnier pour la résistance aux stigmatomycoses.** [Cotton selection for resistance to stigmatomycoses.]—*Publ. Inst. nat. Étud. agron. Congo Belge*, Sér. sci., 16, 29 pp., 3 figs., 7 graphs, 1939.

Detailed results are given of investigations carried out in the Belgian Congo on the selection of cotton strains resistant to stigmatomycosis, caused chiefly by *Nematospora coryli* and *Ashbya* [*N.*] *gossypii* [*R.A.M.*, xviii, p. 308], resistance being tested by means of artificial infections of the bolls. It was found that family 145 of Triumph Big Boll is resistant to both fungi and, in addition, has remarkable commercial qualities. Subfamily 145-C-55-214 (referred to as 145-214) is resistant to *N. coryli*, and two subfamilies of 145 proved equally resistant to *N. gossypii*. Line 10-F-122 appears to show resistance to *N. gossypii* and deserves further study.

BRIXHE (A.). **La fusariose ou 'wilt' du Cotonnier.** [Fusariosis or 'wilt' of the Cotton plant.]—*Bull. Com. coton. congol.*, iv, 14, pp. 49-54, 4 figs., 1939.

The appearance of cotton wilt (*Fusarium vasinfectum*) in the northern districts of the Belgian Congo during the last growing season [*R.A.M.*, xviii, p. 248] having been authoritatively announced by the Inéac Phytopathological Service, the writer gives a semi-popular account of the causal organism, and its control by stringent sanitary precautions in the field and the development of resistant varieties.

COSTA (A. S.) & FRAGA (C. G.). **Sôbre a natureza da ramulôse ou superbrotamento do Algodoeiro.** [On the nature of ramulosis or excess budding of Cotton.]—*J. Agron., S. Paulo*, ii, 3, pp. 151–160, 2 figs., 1939. [English summary.]

A cotton disease in São Paulo, previously described by the authors in *Bol. téc. Inst. agron., Campinas*, 29, 1937, as 'excess budding' or 'ramulosis', the cause of which was obscure, is now tentatively attributed to a new variety of *Colletotrichum gossypii*, referred to as var. *cephalosporioides* [without a diagnosis]. This variety closely resembles *C. [Glomerella] gossypii* in its morphological characters, and may, in fact, be merely an exceptionally aggressive form of the anthracnose fungus [*R.A.M.*, xvi, p. 606]. The two organisms, however, besides differing culturally, show marked divergences in pathogenicity towards the Barberton C. 96 and Gatooma varieties of *Gossypium hirsutum*. Thus, in an inoculation test on 40 Barberton plants with spore suspensions of both fungi, *C. gossypii* var. *cephalosporioides* infected 16 and *G. gossypii* none, while in four trials on Gatooma the former gave positive results in 34 out of 36, 13 out of 14, 7 out of 15, and 15 out of 15 cases, while the latter was uniformly unsuccessful in inducing the typical symptoms of the disease.

DRECHSLER (C.). **Five new Zoopogaceae destructive to Rhizopods and Nematodes.**—*Mycologia*, xxxi, 4, pp. 338–415, 5 figs., 1939.

Latin and English diagnoses and full descriptions are given of one new genus and five new species of Zoopagaceae [*R.A.M.*, xviii, p. 454] destructive to soil rhizopods and nematodes and occurring in decayed plant remains and leaf moulds in the United States, namely: *Stylopage scoliospora*, *S. rhynchospora*, *Cochlonema pumilum*, *C. fusisporum*, and finally *Euryancale sacciospora* n.g., n.sp. The last-named, which is destructive to nematodes belonging to a species of *Bunonema*, gives rise to a conidial apparatus differing from any hitherto represented in this group and thus makes necessary the erection of a new genus. A sexual stage has been observed only in *S. rhynchospora*, and an expanded account is also given of the sexual stage of *S. araea*, a species described in a previous paper [*ibid.*, xiv, p. 508].

MAINS (E. B.). **Cordyceps from the mountains of North Carolina and Tennessee.**—*J. Elisha Mitchell sci. Soc.*, lv, 1, pp. 117–129, 4 pl., 1939.

This is a list of 20 species of *Cordyceps* occurring in the mountainous area of western North Carolina and eastern Tennessee, with a key to the species and a host index. Three new species are described, namely: *C. thaxteri*, the conidial stage of which is apparently *Isaria arachnophila*, later renamed by Petch *Hymenostilbe arachnophila* [*R.A.M.*, xi, p. 299], *C. hesleri*, and *C. smithii*.

TIFFNEY (W. N.). **The identity of certain species of the Saprolegniaceae parasitic to fish.**—*J. Elisha Mitchell sci. Soc.*, lv, 1, pp. 134–151, 1939.

In this study 128 strains of Saprolegniaceae were isolated in southern

New England from living diseased fish, newts, frogs, and turtles; representative strains were then reisolated from single spores and their pathogenicity proved in inoculation experiments. Of the strains isolated, two formed sexual organs and were identified as *Saprolegnia ferax* [R.A.M., xvi, p. 745], 122 strains lacked the sexual stage and are referred to *S. parasitica* [ibid., xviii, p. 591], three belonged to *Achlya* (two of these to *A. flagellata* [ibid., xviii, p. 454]), and one to *Dictyuchus* (probably *D. monosporus*). One of the two strains of *S. ferax* obtained resembled in its asexual stage *S. parasitica* and was induced to fruit by growing it on a whole hemp seed with the seed coat punctured by one small prick. Of the strains of *S. parasitica* present some agreed closely with Coker's type species while others differed in various respects, but these more or less marked variations in vegetative and asexual reproductive structures are not considered to be of diagnostic value and merely extend the present range of variation within the species. In the author's view *S. parasitica* should be considered a species of convenience until further studies have demonstrated its exact nature. He does not accept the establishment of the variety *kochhari* by Chaudhuri and Kochhar [Proc. Indian Acad. Sci., ii, pp. 137-154, 1935] on the basis of zoosporangial length, since the range of this length should be extended to include forms measuring from 70 to 893 μ . The method of zoosporangial renewal by cymose branching was found to be more variable and therefore of less diagnostic value than might be expected, and in view of these findings the author sees no necessity for transferring *S. parasitica* to the genus *Isoachlya*.

The strains of *Achlya* and that of *Dictyuchus* were shown to be wound parasites; so far as the author is aware this is the first record of a species of *Dictyuchus* parasitic on animals.

PRATT (H. N.). **Mold spore content of the air in Boston with reference to atopic sensitivity.**—*J. Pediat.*, xiv, 2, pp. 234-241, 1 diag., 2 graphs, 1939.

The writer exposed Petri dishes containing Sabouraud's agar to the outside air of Boston, Massachusetts, for half-an-hour daily for 14 months (February, 1937 to April, 1938). *Alternaria*, *Hormodendrum*, and unidentified non-spore-bearing moulds increased gradually in numbers during the spring, reached a climax from July to September, and declined in October and November, whereas no seasonal fluctuations were shown by *Aspergillus* and *Penicillium*, and the slight multiplication of *Chaetomium* in August and September is regarded as insignificant. Of 177 children suffering from asthma and hay-fever, 25 per cent. reacted strongly to the intracutaneous injection of *Alternaria* [R.A.M., xviii, p. 737] extracts, the numbers responding similarly to *Aspergillus*, *Hormodendrum*, and *Penicillium* being only 4, 6, and 2.5 per cent., respectively. The seasonal incidence of symptoms among the patients reacting positively to mould extracts closely corresponded to the variations in the spore content of the atmosphere, taking into account the effect of coexisting pollen sensitivity. Nine out of eleven children given specific mould therapy in 1937 obtained marked relief.

NIÑO (F. L.). **Aspectos microscópicos de los granulomas llamados blastomicóticos.** [Microscopic aspects of the so-called blastomycotic granulomata.]—*Prensa méd. argent.*, xxv (ii), 47, pp. 2203–2214, 16 figs., 1938.

This is a detailed account of the histological reactions of various organs of the human body to invasion by certain fungi causing the development in the Argentine of the so-called 'blastomycotic' granulomata, viz., *Cryptococcus* [*Debaryomyces*] *neoformans* [*R.A.M.*, xviii, p. 676], *Paracoccidioides brasiliensis* [*ibid.*, xviii, p. 252] and *P. cerebriformis* [*ibid.*, xvi, p. 318], *Coccidioides immitis* [*ibid.*, xviii, p. 594 and next abstracts], *Zymonema* [*Endomyces*] *dermatitidis* [*ibid.*, xviii, p. 677], various agents of chromoblastomycosis, e.g., *Phialophora*, *Acrotheca*, and *Hormodendrum* spp. [*ibid.*, xviii, p. 28], and *Rhinosporidium seeberi* [*ibid.*, xviii, p. 593].

HYNES (K. E.). **Coccidioidal granuloma.**—*Northwest Med.*, Seattle, xxxviii, 1, pp. 19–21, 4 figs., 1939.

Full clinical details are given of two cases of systemic coccidioidal granuloma (*Coccidioides*) [*immitis*: see preceding and next abstracts], both contracted in California, in young male Filipinos, one of whom succumbed to the disease while the other made an apparently complete recovery following the administration of sulphanilamide over a period of six weeks.

FARNES (O. J.) & MILLS (C. W.). **Coccidioides infection: a case of primary infection in the lung with cavity formation and healing.**—*Amer. Rev. Tuberc.*, xxxix, 2, pp. 266–273, 6 figs., 1939.

The authors describe a case of pulmonary infection by *Coccidioides immitis* [see preceding abstracts], probably primary in the lung, following an insect sting in a 15-year-old Michigan boy at the Desert Sanatorium, Arizona. Unusual features of the disease include its development outside California, the absence of constitutional symptoms, and early cavity formation. A cure was effected by rest, artificial pneumothorax, and specific vaccine therapy.

DANG-VAN-NGU. **La piedra noire au Tonkin et en Annam.** [Black 'piedra' in Tonkin and Annam.]—*Ann. Parasit. hum. comp.*, xvii, 4, pp. 359–363, 1 pl., 1939.

In March and April, 1939, the author observed several cases of the hair affection, black 'piedra', on male students in Annam and Tonkin. The nodules were hard, adherent, opaque, truncated, irregularly cylindrical or fusiform, not over 1.5 mm. long by 0.5 mm. wide. The fungus of which they consisted agreed with the descriptions of *Piedraia hortai* [*R.A.M.*, xviii, p. 526], showing asci, arranged perpendicularly to the axis of the hair, 30 to 50 (average 44.8) by 25 to 30 (average 31.6) μ , each with 8 S-shaped ascospores, 38 by 6 μ , bearing polar filaments 8 to 10 μ long. Cultures from this material gave characteristic black colonies in five days. Transverse sections of affected hairs showed the raising of the epidermal cuticle described by Brumpt and Langeron [*ibid.*, xiii, p. 512], which could be folded over upon itself and sometimes contained asci in the concave part, simulating true perithecia.

It was found that in many cases the hyphae passed into the hair fibrils, concentric lamellae forming on the surface. Sometimes the hyphae reached the medulla of the hair directly, by passing along a radial fissure. The lesions did not render the hair brittle. The known geographical distribution of the disease shows that black 'piedra' has a strong affinity for very wet climates.

CALINISAN (M. R.). **A comprehensive study on symptoms of Abacá mosaic.**—*Philipp. J. Agric.*, x, 2, pp. 121–130, 9 pl., 1939.

The first symptom of abacá [*Musa textilis*] mosaic [*R.A.M.*, xiv, p. 311; xviii, p. 397] in the Philippine Islands is the appearance of spindle-shaped chlorotic areas, measuring 20 to 30 by 2 to 3 mm., on the under side of the leaf parallel to the veins. The chlorotic areas are at first localized, but later they may coalesce and vary in colour from pale yellowish green to a rusty brown. There is often a green dot in the centre of each area. On the unfurled leaves the patterns may be sharply delineated. On the youngest folded leaf the characteristic symptom consists of bands of yellowish streaks alternating with wider stripes of normal green. Infected leaves are sometimes irregularly corrugated. Occasionally a mosaic-infected leaf is followed by an apparently healthy one, but the symptoms reappear on succeeding leaves. Leaves produced prior to infection do not develop symptoms.

Occasionally the first symptom appears as light yellow or orange streaks on the midrib. The subsequent leaf may show more distinct, elongated, yellowish streaks on the petiole or midrib, with no mottle on the leaf. The next ensuing leaf may show characteristic mottling of the petiole, midrib, and leaf blade. As a rule, when the petioles of an infected leaf is salmon or rusty, the inner tissues are discoloured or necrotic. In more advanced stages the tissues turn black and die. The streaks on the midrib, and petioles vary in size and shape, appearing dark green with a yellowish background.

Similar symptoms may appear on the pseudostem and, when present, are clearly visible if the outermost leaf sheath is removed. Newly emerged inflorescences may show distinct spindle-shaped streaks on the outer surface of the bract. When the infected bracts are removed they leave discoloured scars on the rachis. Diseased fruits show violet, wedge-shaped streaks on all four sides, and when cut open reveal a brown discoloration of the inner tissues. Occasionally such fruits are sterile and decay.

CURTIS (J. T.). **The relation of specificity of Orchid mycorrhizal fungi to the problem of symbiosis.**—*Amer. J. Bot.*, xxvi, 6, pp. 390–398, 9 figs., 1939.

In continuation of his studies on orchid mycorrhiza [*R.A.M.*, xvi, p. 466] the author reports that isolations of mycorrhizal fungi from 23 species of orchids from the United States and Mexico yielded ten species of *Rhizoctonia*, including two new ones and one new variety [with diagnoses in English only]. Of these, *R. borealis* n.sp. (isolated from *Goodyera repens* var. *ophioides* and *Spiranthes gracilis*, both in Wisconsin) is described as showing tan, later dark-brown, mycelium, numerous sporodochia up to 3 mm. in diameter, distinct from the rapidly growing

mycelium, and *Clostridium*-like 'spores' measuring 37 to 42 by 24 to 28 μ . In liquid cultures the fungus formed a mat of aerial hyphae. The hyphal tips are characterized by an unusual regularity of dichotomous branching before spore formation. It is very similar to *R. mucoroides* except for its much larger size. *R. monilioides* n.sp. shows cottony aerial hyphae on agar cultures. No sporodochia are formed. The spores, measuring 10 to 14 by 7 to 10 μ , are arranged in branched, monilioid chains comprising from 10 to 18 spores. It differs from *R. repens* in the very long spore chains, slightly smaller spores, and absence of sporodochia. *R. subtilis* var. *nigra* n. var. differs from the typical species by its black mycelium and larger size (10 to 13 by 7 to 9 μ) of its spores.

No evidence of specificity was found in the orchid-fungus relationship, as one species of orchid could harbour as many as four species of *Rhizoctonia* and one species of *Rhizoctonia* could infect seven different orchids. Additional proof was obtained of a correlation between the fungus species and ecological habitat, though a few species occurred in a variety of habitats. Further evidence of non-specificity was afforded by the fact that the fungi isolated from an orchid were mostly unable to induce germination of its seed. It is concluded that the symbiotic relationship is one of parasite and host, the orchid deriving no benefit from the presence of the fungus in its roots.

CHESTERS (C. G. C.) & HICKMAN (C. J.). **Preliminary report on stem and root rot of Viola and Pansy.**—Reprinted from *Nat. Viola & Pansy Soc. Yearb.*, 1938, 8 pp., 7 figs., [1939].

The most serious disease affecting violas and pansies in England is probably the complex known as root and stem rot. The first sign of attack is yellowing of the leaf margins, the discoloration spreading over the surface and being followed by the appearance of purple or purple-brown tints. Finally, the leaves wilt and shrivel, and the entire plant collapses. The diseased plants fall into two classes, viz., those infected by *Myrothecium roridum* [*R.A.M.*, xvi, p. 319], which is normally confined to the stem near soil-level, and those attacked by *Corticium solani* or species of *Pythium* [*ibid.*, xvi, p. 813], both of which affect the root system and stem. In this second form of the disease (the subject of the present study), the mycelium of *C. solani* only is usually found when the diseased tissue is dry, but if it is soft and moist, species of *Pythium* are almost always present, though sometimes accompanied by *C. solani*. Infection reaches epidemic proportions after the setting of the first blooms, while a slow form also occurs on cuttings or second year plants in winter. As a rule, one fungus is responsible for epidemic outbreaks, while two or more organisms may be present in the slow form.

Three species of *Pythium* referred to as types D, E, and H) were isolated from diseased material. Placed in soil under the roots or round the collar of established plants all three types produced typical root and stem rot, as they did when clean viola seedlings were planted in inoculated garden soil.

The disease was observed to be most prevalent on heavy clay soils and those made heavy by the addition of heavy dressings of organic matter, the soils in question being almost invariably extremely moist. It is believed that the disease will cease to cause trouble if violas are

grown in fertile, open soil, the surface of which is protected from excessive heating. Spread was arrested by the prompt removal and destruction of diseased plants, and applications between the plants of Cheshunt compound. The disease is only carried by cuttings containing infected tissue and taken from plants with soft, discoloured stems, but clean, poor-quality cuttings may produce weak roots which easily become infected.

YARWOOD (C. E.). **An overwintering pycnidial stage of *Cicinnobolus*.**—*Mycologia*, xxxi, 4, pp. 420–422, 1 fig., 1939.

In experiments carried out during the years 1931 to 1936 in Indiana, Wisconsin, and California, the author found a pycnidial stage of *Cicinnobolus cesatii* [R.A.M., xvii, p. 843], a parasite of *Erysiphe* spp., developing saprophytically in the tissues of dead overwintered leaves of clover and cucumber, which had been inoculated while living in the previous autumn with *Erysiphe polygoni* and *E. cichoracearum*, respectively, and then with *C. cesatii*. Pycnidia formed parasitically are light brown, thin-walled, 39 to 54 by 18 to 29 μ , discharging spores, 3.5 to 8.4 by 1.9 to 4.1 μ , through an irregular opening at the apex; those formed saprophytically are dark brown, thick-walled, spherical, 79 to 140 μ in diameter, with a well-formed ostiole, and spores 6.0 to 11.1 by 1.8 to 3.2 μ . Cultures from the overwintered leaves were parasitic on living clover mildew and the fungus is believed to overwinter in the saprophytic form.

RICHTER (H.). **Die Viruskrankheiten der Lupine. Mit Anhang: Übertragung und Überwinterung des Lupinenbräune-Virus von K. Heinze.** [The virus diseases of the Lupin. With addendum: the transmission and overwintering of the Lupin browning virus by K. Heinze.]—*Mitt. biol. Anst. (Reichsanst.)*, Berl., 59, pp. 75–86, 12 figs., 1939.

Descriptions are given of lupin mosaic [R.A.M., xvi, p. 518] and browning in Germany [ibid., xvi, p. 680], the former affecting *Lupinus mutabilis*, *L. luteus*, and *L. angustifolius*, the last-named in an atypical manner, involving chlorosis, suppression of flowering, and the development of a witches' broom habit.

All the commercial varieties are susceptible to browning, *L. angustifolius* being the most and *L. mutabilis* the least so. Positive results in the transmission of browning (cucumber virus 1) from diseased to healthy plants were obtained with *Myzus persicae*, *Aphis rumicis*, *Doralis* [A.] *rhamni*, and *M. pseudosolani*, among which *A. rhamni* has not hitherto been recorded as a vector. The following plants were found to act as alternate hosts of the virus in the Berlin district: cucumber, spinach, tomato, tobacco, *Galinsoga parviflora*, *Capsella bursa-pastoris*, *Viola tricolor*, *Stellaria media*, *Chelidonium majus*, *Datura stramonium*, *Aquilegia vulgaris*, *Senecio elegans*, *Zinnia elegans*, China aster, wall-flower, *Eryngium planum*, and *Scabiosa maritima* var. *atropurpurea*. Since the virus does not overwinter in its insect carriers and is not seed-borne, it is apparent that hardy garden annuals and perennial or annual weeds provide the sole means of perpetuation. Lupin crops should therefore not be cultivated in proximity to gardens or

horticultural establishments. The thorough eradication of weeds is an indispensable precaution, and early sowing is advisable in areas where there is a risk of virus infection.

Report of the Low Temperature Research Laboratory, Capetown, 1936-1937.—184 pp., 28 figs., 4 diags., 22 graphs, 1938. [Received August, 1939.]

On pp. 38-53 of this report [cf. *R.A.M.*, xvii, p. 469] R. DAVIES, W. W. BOYES, and D. J. R. DE VILLIERS give further results of their investigations into the internal breakdown of Japanese plum varieties. A storage temperature of 34° F. for 24 days and subsequent ripening at 65° proved unsuitable, as far as breakdown is concerned, for the varieties Santa Rosa (ripest fruits), Wickson, Gaviota (some consignments), Methley, Apple, Satsuma, and Chalcot, and suitable for Santa Rosa (greenest fruits), Gaviota (some consignments), Beauty, and Formosa; a storage temperature of 45° proved unsuitable for Wickson (ripest fruits), Methley, Beauty, and Chalcot (ripest fruits), and suitable for Santa Rosa, Wickson (greenest fruits), Gaviota, Apple, Satsuma, Chalcot (greenish fruits), and Formosa. For the Methley variety storage at 31° is indicated, and it is probable that temperatures above 45° may be best for Wickson. The ripest stage, as measured by the pressure test, that will yield fruit free from breakdown and allow at least five days for ripening at 65° after storage at 45°, is given as 12, 13 to 15, 10 to 12, 15, 12 to 14, and 7 to 8 for the varieties Santa Rosa, Wickson, Gaviota, Apple, Satsuma, and Formosa, respectively. Delayed storage of Santa Rosa plums at 31° resulted at first in an increase in the amount of breakdown and then a decrease after 7 to 10 days; delayed storage at 37° resulted in a decrease up to 7 days, then an increase up to 13 days, and a second fall at still further delay.

From further experiments on woolliness of Peregrine peaches [loc. cit.], R. DAVIES, W. W. BOYES, and D. J. R. DE VILLIERS (pp. 53-67) draw the following conclusions: no woolliness is produced during storage for 24 days at 31° irrespective of the period of delay; the condition increases with an increase of storage temperatures; when temperatures higher than 31° are used woolliness can be reduced to reasonable proportions by pre-storing for two to three days at 75°, four or more days at 65°, and eight or more days at 50°, although it is noted that delayed storage at 50° produces abnormalities in ripening other than those of woolliness. The lower the temperature of storage the better the quality of the fruit, and the higher the storage temperature the greater the intensity and incidence of 'pink flesh'; ripening the fruit at 65° following storage at 34° and 37° (but not 31°) encourages the development of 'pink flesh', while ripening the fruit at 45° reduces it to negligible proportions except in fruit stored at 37°.

In experiments on grape wastage, due to *Botrytis* [*cinerea*: *ibid.*, xvii, p. 499] and *Penicillium* [*ibid.*, xvi, p. 437], conducted during 1937 by J. M. RATTRAY (pp. 75-91), the wastage of Gros Colman grapes showed a general tendency to increase with maturity. Wilting over night before packing did not significantly increase the *Botrytis* wastage in Raisin Blanc grapes, but it increased the percentage of 'loose neck' from 3.4 in grapes packed immediately after picking to 8.5. Treating

sulphite wrappers with orthophenylphenol [ibid., xviii, p. 589] reduced the *Penicillium* wastage in Gros Colman grapes from 8.5 to 1.1 per cent., but the percentage of *Botrytis* wastage was even higher than in the control; the same substance used in wax (10 gm. in 100), however, reduced *Botrytis* wastage in Henab Turki grapes from 69 to 21.7 per cent., but several bunches developed an off-flavour. Dipping Gros Colman grapes in a solution of 95 per cent. alcohol and 4 per cent. acetic acid for a few seconds reduced the percentage of *Botrytis* wastage in the trimmed bunches from 100 to 28, but had no effect on untrimmed ones. Fumigation on a commercial scale with 3 or 5 per cent. formaldehyde reduced *Botrytis* wastage in White Hanepoot and Henab Turki grapes but the amount of drop was increased in every case. The stronger concentration of formaldehyde had an adverse effect on the condition of stems.

Data obtained by E. BEYERS (pp. 91–101) during 1937 again confirmed the detrimental effect of delayed and long storage on the incidence of drop in Waltham Cross grapes [loc. cit.]. The results of 1937 again showed that grapes picked at a riper stage were slightly less susceptible to drop than green grapes. So far the only available means of checking drop lies in the prompt cooling of the grapes after picking and the provision of ample soil moisture.

J. M. RATTRAY and E. BEYERS (pp. 102–112) conclude from the results of their experiments that although the use of waxed crystalline paper wrappers for grapes has a beneficial effect on the general appearance of the bunches and the freshness of the stalks, yet the susceptibility to mould wastage [*B. cinerea* and *Penicillium*] is correspondingly increased and may assume far more serious proportions than with the sulphite wrappers.

J. E. VAN DER PLANK (pp. 159–172), describing the different forms of cold injury on Marsh grapefruit, states that at a storage temperature of 31.5° the injury usually appears in the form of numerous pin-head pits, either scattered over the whole surface of the fruit; or clustered together over a small portion of it, the symptoms being similar to the 'mild' pitting, described by Brooks and McColloch [ibid., xv, p. 498]; at 35° the pits are usually larger and more distinct and are surrounded by a halo, resulting from the browning of the tissue between the oil cells; at 39° the pits are well defined, up to $\frac{1}{4}$ in. or more in diameter, and show concentric halos; and at 45° large and diffuse brown blotches tend to develop instead of pits. Navel oranges stored at 30° to 32° are stated to show 'gooseflesh' [ibid., xvii, p. 444]; at 35° a browning of the tissue round the oil vesicles and a number of irregular small pits may occur; and at 39° to 45° well-defined pits develop, usually surrounded by a halo, while browning is relatively rare. No confirmation was found for the alleged fungal origin of button-browning [ibid., xiv, p. 755] and the trouble is attributed to cold injury. Styler end blotching of grapefruit, characterized by small irregular blotches, often associated with a halo, was observed to occur frequently, particularly at the end of the season, but is thought to be of little importance. Three types of lesions were found on Navel oranges stored at 55° and to a lesser extent at 50°, but not at lower temperatures, characterized by (a) brown to almost black, circular, occasionally irregular spots, slightly sunken, but not penetrating deeply into the

rind, closely resembling 'brown spot' described by Fawcett [ibid., xv, p. 574]; (b) irregular and more sunken spots found in coarser-skinned fruits; and (c) irregular, shallow, brown to black spots appearing within a month and greatly increasing with prolonged storage. Types (a) and (b) are due to physiological breakdown and (c) to an unidentified fungus.

In cold storage tests with Rome Beauty apples, described by W. E. ISAAC and W. W. BOYES (pp. 180-184), the higher the storage temperature the sooner did superficial scald develop, but temperature had little effect on its incidence.

GAUDINEAU [Mlle (M.)], RAUCOURT, & MOREL (G.). **Observations sur la forme parfaite de *Venturia inaequalis* et de *Venturia pirina*.** [Observations on the perfect form of *Venturia inaequalis* and *V. pirina*.]—*Rev. Path. vég.*, xxvi, 2, pp. 148-154, 2 pl., 1939.

In this paper the authors give details of the occurrence of *Venturia inaequalis* on apple and *V. pirina* on pear in the perfect stage in France, the record of which has already been noted from another source [*R.A.M.*, xviii, p. 688: but note, p. 689, l. 4, for 'perithecia' read 'conidia'].

SCHAD (C.) & SOULIÉ (H.). **Note sur la recherche des périthèces des tavelures du Pommier et du Poirier dans la région du Centre en 1938.** [A note on the search for the perithecia of Apple and Pear scab in Central France in 1938.]—*Rev. Path. vég.*, xxvi, 2, pp. 160-162, 1939.

In this note the authors discuss the occurrence of perithecia of *Venturia inaequalis* on apple and *V. pirina* on pear in central France, the record of which has already been noted from another source [see preceding abstract].

GOLDSWORTHY (M. C.) & GREEN (E. L.). **The fungicidal activity of phenothiazine and some of its oxidation derivatives.**—*Phytopathology*, xxix, 8, pp. 700-716, 1939.

A fully tabulated account is given of the writers' laboratory experiments on the toxicity of saturated solutions of phenothiazine and its derivatives, phenothiazine sulphoxide, phenothiazone, and thionol, and of weathered and non-weathered phenothiazine-lime-bentonite residues to the conidia of *Sclerotinia fruticola* and *Glomerella cingulata*, supplemented in the case of phenothiazine only by field tests in the control of apple scab (*Venturia inaequalis*).

Phenothiazone proved to be the most effective fungicide of the group, destroying the conidia of *S. fruticola* and *G. cingulata* at a concentration of several parts per million. It was shown, by chloroform solubility, sublimation, and spectrum absorption and transmission tests, to be the toxic product resulting from the oxidation of phenothiazine and phenothiazine sulphoxide in the presence of air, light, and water. Phenothiazine residues and saturated aqueous solutions, unaltered by oxidation, were non-toxic to the conidia of both organisms. Good control of apple scab was obtained in an Indiana orchard by the application of phenothiazine sprays, wetted by soluble fish-oil soap, at the rate of 2 lb. per 50 gals. water.

The conidia of *S. fructicola*, but not those of *G. cingulata*, succumbed to phenothiazine sulphoxide oxidized in alkaline residues. Saturated aqueous solutions of the same compound, following oxidation by strong light in the presence of air, were toxic to the conidia of both fungi.

Oxidized thionol residues destroyed the conidia of *S. fructicola* but not those of *G. cingulata*, while saturated solutions of thionol were non-toxic to both.

BAINES (R. C.). **Phytophthora trunk canker or collar rot of Apple trees.**—*J. agric. Res.*, lix, 3, pp. 159–184, 1 pl., 4 figs., 1939.

This is a full account of the author's investigations into the canker or collar rot disease of apple trees (*Phytophthora cactorum*), most of which has been reported from other sources [*R.A.M.*, xiv, p. 371; xvii, p. 399; xviii, p. 320]. From a review of the relevant literature the author concludes that the disease occurred in Indiana as early as 1900. In six orchards the percentage of infection of Grimes Golden trees (14 to 18 years old) ranged from 21 to 85 during 1933–4 and in two of these orchards from 0 to 6 per annum from 1935 to 1937. Partial control of the disease on Grimes Golden was obtained in one orchard by spraying with Bordeaux mixture 16–16–100 and 30–30–100 after the dormant period, the percentage of trees showing canker development during 1935, 1936, and 1937 being thereby reduced from 9, 4, and 0·8 on the unsprayed controls to 3, 1, and 0·6, respectively. Treatment of trunk cankers with a 10 per cent. solution of sodium arsenite in 50 per cent. alcohol seemed to check their further development.

WILLISON (R. S.). **Fall spray injury to Peach trees.**—*Sci. Agric.*, xix, 11, pp. 670–672, 2 pl., 1939.

In March, 1938, peach trees near Lake Ontario sprayed in November, 1937, with a 1:7 lime-sulphur mixture showed injury, mainly confined to weak, slender twigs, formed late in the growing season. Many of these had been killed, while in others injury was confined to small, necrotic areas round the leaf scars. Sections of leaf bases showed no periderm formation, the only barrier to penetration through the scar being a protective layer of dead tissue. In the injured leaf bases the spray had penetrated and bleached this layer, while in mounted sections crystals (apparently of elemental sulphur) had formed over the surface of the bleached areas, probably precipitated by the lactophenol mounting solution. Trees in another orchard sprayed with lime-sulphur in November, 1937, showed no injury in the following March, but under leaf scars covered with spray residue bleaching, with a crystal deposit as in injured twigs, was noted in the outer part of the protective layer. In no instance, however, had penetration reached the living cells. The evidence indicates that in cases of injury from autumn spraying with lime-sulphur the leaf scar with its leaf traces is a main avenue of penetration.

WARDLAW (C. W.). **Cercospora leaf spot disease of Bananas.**—*Nature, Lond.*, cxliv, 3635, pp. 11–14, 2 figs., 1939.

The author gives a concise account of banana leaf spot (*Cercospora musae*) [*R.A.M.*, xviii, p. 748] as it occurs in Trinidad.

BAKER (R. E. D.). **Papaw mosaic disease.**—*Trop. Agriculture, Trin.*, xvi, 7, pp. 159–163, 13 figs., 1 graph, 1939.

Papaw mosaic [*R.A.M.*, xvi, p. 729] is stated to be very common in Trinidad, where it appears to be still gaining ground. The symptoms are very variable. Typically water-soaked areas, known as 'oil spots', on the petioles and a marked mosaic on the laminae of newly formed leaves appear almost simultaneously, while older leaves remain unaffected. In some cases no marked mosaic but only a general chlorosis develops. The growing point usually becomes involved after three to four weeks and the crown of the tree dies after eight to nine, a secondary rotting setting in rapidly followed by a profuse development of the lower axillary branches. There is evidence that vigorous trees are more readily attacked than weaker ones. Trees have been observed to recover naturally and sometimes are attacked more than once.

The disease, as it occurs in Trinidad, is believed to be identical with mosaic described from Jamaica [*ibid.*, xi, pp. 26, 625], and one type of 'curly leaf' from San Domingo [*ibid.*, ix, p. 512] where two diseases appear to have been described as one. The Trinidad disease is considered to be distinct from the bunchy top of Puerto Rico [*ibid.*, xviii, p. 375], although it might be caused by another strain of the same virus, and from the second type of 'curly leaf' from San Domingo which is believed to be identical with bunchy top. A disease similar to that in Puerto Rico is reported from Queensland under the name of 'yellow crinkle' [*ibid.*, xviii, p. 657]. Discussing the possible cause of the disease, the author expresses the opinion that it is probably caused by an insect-borne virus and belongs to the group of virus diseases transmissible by insects only and not by sap inoculations. By far the commonest insect in the plantations was an Aleyrodid white fly which is considered to be a possible vector, though transmission experiments with it, and by sap inoculation or grafting, have so far given negative results. For control the trees should be cut back at least 3 or 4 ft. behind the growing point, and as the stem is hollow, the cut surface should be covered with an inverted jam tin or filled in with concrete as a protection against the breeding of mosquitoes and the eventual rotting of the tree. This method has proved successful on a small scale in Trinidad, but it has yet to be tested on a large one.

ROBERTSON (W. C.). **Fungicides Act 1935. Registrations for the year 1939.**—*J. Dep. Agric. Vict.*, xxxvii, 6, pp. 281–283, 301, 2 figs., 1939.

This is a general critical survey of over 400 brands of fungicides and insecticides (a list of which is issued as a supplement to the *Journal*) registered under the Fungicides Act for the year 1939 in Victoria.

GARRETT (S. D.), GLYNNE (MARY D.), HICKMAN (C. J.), WILLIAMS (P. H.), & OGILVIE (L.). **Symposium and discussion on root rots.**—*Trans. Brit. mycol. Soc.*, xxiii, 2, pp. 209–213, 1939.

In a symposium held at the meeting of the British Mycological Society on 28th January, 1939, in London, S. D. Garrett discussed the ecology and world distribution of cereal root rot fungi [*R.A.M.*, xvii, p. 625],

classifying *Ophiobolus graminis* on wheat as a semi-obligate parasite and *Fusarium culmorum* as a typical facultative parasite.

In a field study on the gradual invasion of the roots of healthy wheat plants by fungi carried out at Rothamsted by Mary D. Glynné during 1936-7, the number of isolations made at four- or six-weekly intervals throughout the growing season is stated to have steadily increased as the season advanced, being very high by June. About 50 per cent. of the fungi isolated were sterile forms, some of them occurring very frequently; of the remainder *Periconia circinata* and an apparently new species of *Pullularia* are worthy of mention.

From the results obtained in a six months' field study at Westerham, Kent, on the 'red core' disease of strawberries [ibid., xviii, p. 123] C. J. Hickman tentatively concludes that a species of *Phytophthora* is the primary cause of this disease, the parasitic activity of the fungus being largely governed by soil wetness. The fungal flora isolated from roots of cultivated and wild strawberry plants suffering from black root rot [ibid., xvi, p. 760] is stated to include species of *Fusarium*, *Rhizoctonia*, *Pythium*, *Cylindrocarpon*, *Coniothyrium*, *Hainesia*, *Alternaria*, *Verticillium*, and *Pachybasidium*, but their relative importance in the etiology of the disease has not yet been determined.

Further contributions to the symposium were made by P. H. Williams, who read a paper on the root rots of glasshouse plants, and L. Ogilvie, who discussed the influence of certain environmental factors on the incidence of five diseases of vegetables prevalent in Worcestershire.

COUCH (J. N.). **Technic for collection, isolation and culture of Chytrids.**—*J. Elisha Mitchell sci. Soc.*, lv, 1, pp. 208-214, 1939.

The following methods are described for the isolation of 15 representative species of Chytridiales [which are listed] in pure fungal culture: (1) isolation in water of a single sporangium, (2) on agar of a single sporangium, (3) of zoospores from a single sporangium on a slide, (4) of a single zoospore in a capillary tube, (5) of a single zoospore on agar, and (6) of a single thread or several threads of mycelium on agar. Some of the isolations have been maintained in culture for as long as seven years. Boiled leaves and pollen were the usual substrata but four species have been grown on boiled filter paper, bacteria being present in such cultures and being apparently necessary for growth. Usually zoospore germination was best on agars with small amounts of nutrient or even on plain agar.

JØRGENSEN (A.), HANSEN (A.), & LUND (A.). **Micro-organisms and fermentation.**—xii+416 pp., 40 pl., 21 figs., London, Charles Griffin & Co., Ltd., 1939. 30s.

This volume, prepared with the assistance of C. Ainsworth Mitchell, is the sixth edition of Jørgensen's well-known book, the text of which has been so extensively revised as to constitute an entirely new work. The original plan remains essentially unaltered, but the manner of presentation has been brought up to date throughout. The parts describing several important biochemical processes have been expanded, and those relating to certain rare micro-organisms omitted. The form

is that of a text-book in which the authors discuss the principal organisms involved in brewing, distilling, yeast manufacture, wine-making, and dairying. Nearly all the original illustrations have been replaced by photomicrographs.

DAMERON (W. H.) & SMITH (H. P.). **Prickly Pear eradication and control.**—*Bull. Tex. agric. Exp. Sta.* 575, 55 pp., 29 figs., 1939.

The authors state that prickly pear [*Opuntia* spp.] in Texas is subject to infection by anthracnose or shot hole (*Gloeosporium lunatum*) [*R.A.M.*, v, p. 303], which, under humid conditions in spring, causes extensive destruction of the young growth. The fungus often effects entry through holes from which the cactus midge (*Asphondylia opuntiae*) has emerged, or it may penetrate through abrasions on the joints. It is also carried by the cactus stink bugs (of which the chief species is *Chelinidea vittiger*) from plant to plant and can set up infection wherever the conditions are favourable.

Virusforschung und Viruskrankheiten. Vorträge der Pflanzenschutztagung der Biologischen Reichsanstalt am 2. Februar 1939. [Virus research and virus diseases. Papers read at the Plant Protection Conference of the Reich Biological Institute on 2nd February, 1939.]—*Mitt. biol. Anst. (Reichsanst.)*, Berl., 59, 92 pp., 50 figs., 14 graphs, 2 diags., 2 maps., 1939.

This is a collection of papers read at the annual conference of the Reich Biological Institute, Dahlem, Berlin, prefaced by E. Riehm.

E. PFANKUCH (pp. 9–12) describes a method of detecting and differentiating plant viruses by measuring the turbidity caused by raw virus juice in solutions of ammonium sulphate. Determinations are made in solutions of 0, 25, and 37.5 per cent. saturation and the ratio of the increase at 25 per cent. saturation to the total increase (at 37.5 per cent.) is expressed as a percentage and termed the so-called turbidity factor. It appeared that the turbidity factor of healthy tobacco juice was considerably lower (average 13 per cent.) than that of mosaic-infected (average 91 per cent.), even when the latter was diluted 1:2 (88 per cent.). Tobacco mosaic virus and two strains of the potato X virus were clearly distinguished by this method, showing not only different turbidity factors, but significantly different curves of turbidity increase. The author expresses the view that this method should also prove adaptable for the quantitative determination of viruses.

The studies by G. A. KAUSCHE (pp. 15–23) on the reactions of tobacco mosaic and potato X viruses to colloidal gold and the formation of hexagonal tobacco mosaic virus crystals *in vitro* have been already noticed from other sources [*P.A.M.*, xviii, pp. 266, 481].

E. KÖHLER (pp. 25–34) discusses the chief problems of virus resistance in plants, such as hypersensitivity and protective inoculation; most of the information has already been noticed in this *Review*.

W. MAIER (pp. 49–60) presents the results of his observations on the symptoms of 'Reisigkrankheit' [or court-noué: *ibid.*, xviii, pp. 294, 510, 652] and leaf roll disease [loc. cit.] of the vine, which are probably caused by viruses. 'Reisigkrankheit' is characterized by short internodes, which were found to be particularly numerous near the

tenth internode, and by double nodes, particularly numerous near the eleventh. Distinct colour reactions were obtained in iodine dye tests: the deep blue colour disappeared after 10 to 20 minutes from iodine-treated expressed sap of vines suffering from the 'reisig' disease, while in sap of healthy vines the discoloration only began after 25 minutes and was completed after many hours. Similarly, the disappearance of colour in the iodine-treated sap of vines affected with leaf roll was more rapid than in that of healthy vines (ten minutes as against several hours).

W. KOTTE (pp. 61-64) makes some observations on fern-leaf of tomato in Baden [ibid., xvii, p. 354] and states that the disease has also been reported by Wenzl from Vienna. He describes a ring spot disease of the pods of beans [*Phaseolus vulgaris*] of the Captain Weddingen variety, observed in 1937 in a field near Heidelberg. The spots were greyish-green to brown and necrotic, and the surrounding tissue was slightly depressed. The leaves of diseased plants showed no spots, but they dried up and died prematurely. *Fusarium solani* var. *martii* [ibid., xviii, p. 291] was found at the stem bases and is believed to be a secondary invader, though possibly responsible for the leaf drop. E. Köhler transmitted the ring spot disease by inoculation to Samson tobacco and identified the symptoms as those of the tobacco ring spot virus. This is believed to be the first record of the occurrence of this virus on bean pods in nature.

C. KAUFMANN (pp. 65-72) states that the most important virus disease of crucifers in Germany [ibid., xvi, p. 10] is not identical with either of the three types described by Tompkins [ibid., xvii, p. 6, 151, 574; xviii, p. 427]. It appears on spring-sown swedes in July as light green spots and lesions on young and later on older leaves. The young leaves formed after the appearance of the disease are smaller than normal and often curled at the margins, which frequently become necrotic. As the number of affected leaves becomes greater the growth of the roots is gradually reduced and finally arrested altogether. Many of the affected leaves die and fall long before the harvest. The disease occurs in a mild form on colza (*Brassica napus* [*B. campestris*] *oleifera*) and summer-sown swedes, retarding the growth of the plant without destroying it, and very severely on rape (*B. rapa oleifera*), usually killing the plant in the autumn or early winter; it also affects turnips. The percentage of diseased plants was smaller in summer crops sown later than usual, possibly because the optimum development of the disease occurs at relatively high temperatures, at which the incubation period is considerably shortened. The losses caused by this disease in Schleswig-Holstein, where hundreds of square kilometres were severely affected, show it to be far more injurious than any virus disease previously described on crucifers. In the greenhouse it was successfully transmitted by infected juice to radishes and charlock (*Sinapis arvensis*) [*B. sinapis*]. It has been observed in Germany in the provinces of Schleswig-Holstein, Mecklenburg, Oldenburg, Brandenburg, Rhineland, Lippe, Westphalia, and Silesia, and has probably been present, but overlooked, in other parts of the country. There is a striking difference in the susceptibility of swedes of different varieties and origins, the white varieties (Heinkenborstel, East Mark White, Pomeranian

Tankard) being generally more resistant than the yellow (Seefeld, Bangholm Herning) with the single exception of the yellow Vogesa, which is practically immune.

SMITH (K. M.). **The study of plant viruses with special reference to their insect-relationships and some comparisons with the animal viruses.**—*Trans. R. Soc. trop. Med. Hyg.*, xxxii, 5, pp. 557–566, 5 figs., 1939.

This is a general survey of the knowledge at present available concerning plant viruses (of which 163 are stated to have been already placed on record), their transmission by insects, and certain parallels with animal viruses. The paper (read before a meeting of the Royal Society of Tropical Medicine and Hygiene on 19th January, 1939) was followed by a discussion (pp. 566–574).

WYCKOFF (R. W. G.). **Purified viruses and virus proteins.**—*Ergebn. Enzymforsch.*, viii, pp. 1–12, 1939.

This is a critical review of recent important developments in the study of purified viruses and their proteins, many of the papers to which reference is made having been noticed from time to time in this *Review*.

MAGROU (J.). **Les protéines-virus cristallisables.** [Crystallizable virus proteins.]—*Rev. Path. vég.*, xxvi, 2, pp. 109–123, 1939.

In this paper the author reviews and discusses recent investigations by Stanley, Bawden, Pirie, and others [all of which have been noticed in this *Review*] on the nature of the crystalline proteins associated with virus diseases and their possible identity with the viruses themselves.

THATCHER (F. S.). **Osmotic and permeability relations in the nutrition of fungus parasites.**—*Amer. J. Bot.*, xxvi, 6, pp. 449–458, 10 figs., 1 graph, 1939.

A study, by means of plasmolytic methods, was carried out on the osmotic pressure and permeability relationships between fungi and hosts, using *Uromyces fabae* on peas, *U. caryophyllinus* on carnation, and *Botrytis cinerea* and *Sclerotinia sclerotiorum* from decaying celery petioles. Osmotic values were determined for the germ-tubes of the uredospores and haustoria of the rusts, the hyphae of the other two fungi, and for host tissues. The results showed that in all cases the osmotic pressure of the fungus was greater than that of its host. In the plants infected by the two rusts, infection increased the permeability of the plasma membrane of the host cells. Increased permeability was also noted in celery tissue some distance away from cells killed by *B. cinerea* or *S. sclerotiorum*.

Discussing these data with reference to the nutrition of the rust fungi, the author points out that the fungus, with its higher osmotic pressure, can remove water from neighbouring parenchyma cells and even maintain turgor in contact with non-turgid host cells or their free sap. The increase in permeability of the host cells, probably caused by some secretion of the parasite, permits some of the vacuolar solutes to become available to the fungus. The outward flow of water and

vacuolar solutes from the host cells will be checked when the wall tension balances the effective osmotic pressure, so that the cells do not lose turgor completely and consequently remain alive. Both *B. cinerea* and *S. sclerotiorum* in tissues as yet unaffected by their pectinase secretion show the same type of relationship as do the rusts, but the increased permeability of the host cells ultimately proves fatal. In the rusts the factor governing the increased permeability of the host cells is reduced in intensity.

STEINBERG (R. A.). **Growth of fungi in synthetic nutrient solutions.**—*Bot. Rev.*, v, 6, pp. 327–350, 1939.

The author sums up the available information on the carbon, nitrogen, mineral, and some organic requirements for the growth and reproduction of various fungi in culture on the basis of the pertinent literature [of which a bibliography of 99 titles is appended].

KÖHLER (E.) & HEINZE (K.). **Zur Methodik der vergleichenden Sortenprüfung auf Y-Virus-Resistenz bei Kartoffeln.** [A contribution to the technique of the comparative varietal testing of Potatoes for resistance to the Y virus.]—*Züchter*, xi, 7, pp. 169–174, 1 diag., 1939.

In order to avoid the fluctuations in intensity of infection liable to occur over small areas, the writers, in their preliminary tests on the varietal reaction of potatoes to virus Y at the Biological Institute, Dahlem, Berlin, in 1937 [*R.A.M.*, xviii, p. 409], spaced the trial plants at regular intervals throughout the plots, interspersed with thoroughly infested tubers of a susceptible variety. So heavy was the infestation of the aphid vector of the disease (*Myzus persicae*) during the season of the experiments that up to 5,400 insects were counted on one plant. By this means it was ascertained that Bodenkraft is superior to Stärkereiche in respect of resistance to the Y virus. In other tests Johanssen was more resistant than Stärkereiche and Fürstenkrone than Erdgold.

MULLER (H. R. A.). **Onderzoekingen over Aardappelziekten.** [Studies on Potato diseases.]—*Meded. alg. Proefst. Landb., Batavia*, 33, 22 pp., 1939. [English summary.]

Field observations in Java are stated to have shown that the potato disease caused by *Colletotrichum atramentarium* [*R.A.M.*, xvii, p. 60] does not constitute a serious danger to the crop except when the seed tubers are shipped too late in the season, or are weakened by adverse physiological conditions. Under appropriate storage conditions the damage is also slight, but where the temperature and atmospheric humidity are allowed to rise unduly, tuber rot may be stimulated. Even 100 per cent. diseased tubers, however, will produce a practically sound crop, and in the light of the information gained from these experiments the drastic quarantine measures enforced at the time of the first outbreak of *C. atramentarium* in the Dutch East Indies have been revised to admit the importation of early harvested consignments shipped before sprouting.

In trials with Eigenheimer and Bevelander potatoes, both relatively

resistant to blight (*Phytophthora infestans*), Bevelander, also highly resistant to virus diseases, was particularly valuable in areas where the regular renewal of seed by importation is impracticable on economic grounds. The blight-resistant Robijn having proved exceptionally susceptible to slime disease (*Bacterium solanacearum*), showing 32.9 per cent. infection in a propagation area compared with 2.2, 0.7, and 0.2 for Record, Populair, and Nationaal, respectively, the distribution of this variety has been discontinued.

[This paper also appears in *Landbouw*, xv, 4, 1939, and as *Meded. Inst. PlZiekt., Buitenzorg*, 93, 1939.]

LIMASSET (P.). **Recherches sur le *Phytophthora infestans* (Mont.) de Bary.** [Researches on *Phytophthora infestans* (Mont.) de Bary.]—*Ann. Épiphyt.*, N.S., v, 1, pp. 21–39, 3 figs., 1939.

In studies on potato blight (*Phytophthora infestans*) carried out at Versailles, the author planted on 26th April, 1938, 291 healthy Early Rose tubers together with 31 of the same variety and six of Bintje inoculated by immersion in a conidial suspension of the fungus (infection plot 1), the inoculated Early Rose tubers being interspersed at regular intervals throughout the plot and the Bintje tubers being planted in one area each next to a healthy Early Rose tuber. In a second plot (infection plot 2) the author planted on 3rd May healthy Saucisse tubers and four infection centres of Early Rose (one of naturally infected tubers) together with one of artificially inoculated Saucisse plants.

Blight appeared in plot 1 on 29th July, when plants from five inoculated tubers growing under the shade of poplars showed infection, as did a certain number of neighbouring plants. The disease spread on 30th July but from 1st August it regressed owing to the dry weather. In plot 2 it appeared on 28th July and spread to a number of plants round each infection focus, and after 10th August the attack was general.

The results showed that seed pieces can be an important source of infection. This was demonstrated both by the plants from artificially inoculated and naturally infected seed tubers, whilst potatoes in the surrounding country remained entirely healthy. Further data indicated that the presence of foci of diseased plants permits the development of localized epidemics even when meteorological conditions are unfavourable to infection. This is explained by the author as due to the great abundance of conidia capable of taking advantage of favourable microclimatic conditions.

From the behaviour of the fungus on the two varieties it was deduced that the amount of infection that develops depends not only on susceptibility, i.e., physiological aptitude to harbour the parasite, but on receptivity, which is conditioned both by susceptibility and microclimatic factors. Two plants of equal susceptibility may show widely different receptivity, for instance, Early Rose is quite as susceptible as Saucisse but much less receptive, as its aerial parts are much less luxuriant and create a less favourable microclimate.

At harvest the plants from the inoculated tubers gave a smaller yield than those from healthy ones, even when no infection was present on the foliage, and sometimes the yield from diseased tubers was only

half that from healthy seed. The diseased plants from healthy tubers showed no decline in yield.

From June to August, inclusive, Beaumont's two weather conditions for infection [*R.A.M.*, xvi, p. 514] were not satisfied, but the disease continued to spread even though humidity was under 75 per cent.

Inoculations with a conidial suspension on separate leaves of Early Rose potatoes in Petri dishes showed that at 20° C. (humidity at saturation) the incubation period was three days, conidiophores appearing two days later. At 17° the corresponding periods were four days and 24 or 48 hours, while at 25° the incubation period was somewhat longer than at 20°. When the inoculations were made at 10° and the subsequent temperatures ranged from 4° to 16°, the incubation period was six days.

SCHAAL (L. A.). **Penetration of Potato-tuber tissue by *Rhizoctonia solani* in relation to the effectiveness of seed treatment.**—*Phytopathology*, xxix, 8, pp. 759-760, 1 fig., 1939.

Eleven out of 32 cultures from the periderm tissue underlying large, non-viable sclerotia of *Rhizoctonia* [*Corticium*] *solani* on potato seed pieces treated in Maine with ordinary or acidulated mercuric chloride [*R.A.M.*, xviii, p. 577] gave rise to the fungus, indicating the possibility (subsequently confirmed by the examination of stained sections) that the mycelium had penetrated the tissues to a depth inaccessible to disinfectants. Invasion was found to be mostly intercellular and to extend through several cell layers; in one section the mycelium (which had presumably entered through a lenticel) had traversed the cork cambium and entered the tissues below the periderm. In such a site it would be protected from complete destruction by antiseptics, a fact that may account for the presence of some infection on treated seed potatoes.

CRALLEY (E. M.). **Effects of fertilizer on stem rot of Rice.**—*Bull. Ark. agric. Exp. Sta.* 383, 17 pp., 1 fig., 1939.

In field trials on the control of stem rot of rice (*Leptosphaeria salvinii* [*R.A.M.*, xvii, p. 128] and *Helminthosporium sigmoideum* var. *irregulare* [ibid., xv, p. 47; xvi, p. 156]), carried out during the years 1936 to 1938 in Arkansas, significant increases in yield resulted from applications of various amounts of nitrogen or phosphorus, but both fertilizers increased the severity of the disease. The effects both on the yield and disease incidence were slightly greater with nitrogen than with phosphorus, and were intensified when the two were applied together instead of separately. Applications of potassium, on the other hand, although of little influence on the yield, did not increase the severity of the disease, and when applied in combination with nitrogen and phosphate (for instance, 600 lb. fertilizer, composed of 6 parts of ammonium sulphate, 8 of superphosphate, and 24 of potassium sulphate per acre, two months after planting) had the beneficial effect of maintaining the intensity of the disease on a level equal to or sometimes below that of the control plots. The addition of sufficient potassium to fertilizers is, therefore, important on stem rot-infested land. The results of sand culture experiments with *L. salvinii* in the greenhouse in general substantiated

those obtained in the field. Plants grown in solutions with high nitrogen and low potassium contents showed a high degree of infection, while on plants grown in solutions with a constant nitrogen and phosphorus content the severity of the disease diminished as the potassium content of the solution was increased.

BEELEY (F.) & BAPTIST (E. D. C.). **Palm oil diluent for tar oil fungicides and its effect on bark renewal of *Hevea*.**—*J. Rubb. Res. Inst. Malaya*, ix, 1, pp. 40–50, 1939.

Experiments are fully described, with a special fungicidal oil [unspecified] of three grades, which, diluted with palm oil, was intended by the manufacturers to control bark disease of *Hevea* rubber and stimulate bark renewal. It was found that the application of controlled quantities of palm oil alone to the freshly tapped bark of old, hard-barked rubber trees very significantly improved subsequent bark renewal owing, it is thought, to the presence of growth hormones in the oil. The use of the fungicidal oils with the palm oil was of no added advantage, except in the control of panel diseases. At strengths of 5 to 10 per cent. the fungicidal oil in palm oil made a suitable mixture for the control of mouldy rot *Ceratostomella fimbriata* [*R.A.M.*, xviii, p. 342], and also promoted bark renewal. The disadvantages accruing from the application of excessive amounts of palm oil to the panel can be obviated by avoiding overlapping in subsequent treatments of a section already treated.

BEELEY (F.). ***Oidium heveae*. A report on the 1939 outbreak.**—*J. Rubb. Res. Inst. Malaya*, ix, 1, pp. 59–67, 1939.

In the north of Malaya, refoliation of *Hevea* rubber in January and February, 1939, was nearly complete before dull weather set in, with the result that there was practically no infection by *Oidium heveae* [*R.A.M.*, xviii, p. 272]. In the central areas, and at the foot of higher hills, wintering was sufficiently delayed to favour mild infection in late-wintering trees, the first blossom being seriously affected. In more southerly districts, refoliation proceeded in bright weather with occasional showers, and there was no serious loss due to infection. Sulphur dusting in various localities was abandoned or curtailed, only two or three applications being made. The fact that infection appeared within 48 hours of the onset of dull weather supports the view that *O. heveae* hibernates in the buds, and that as these open the mycelium, favoured by dull, cool, humid conditions, produces an early crop of conidia which rapidly become disseminated.

MURRAY (R. K. S.). ***Oidium* leaf disease in Ceylon in 1939.**—*Quart. Circ. Ceylon Rubb. Res. Scheme*, xvi, 2, pp. 81–88, 1 graph, 1939.

During 1939 *Oidium* [*heveae*: *R.A.M.*, xvii, p. 770] is stated to have caused considerable damage in certain low-country localities in Ceylon following spells of very dry weather. The disease is believed to have been favoured by exceptionally low night temperatures in January and February, which were apparently not offset by high day temperatures, and unusually high atmospheric humidity in the early morning, recurring despite the dry weather. Sulphur dusting was extremely

successful in the Matala district in the low country, but the results on other estates in a similar situation were disappointing. Spells of cold weather being abnormal in January and February, it is not considered necessary to modify the present recommendations for dusting, but such spells should be recognized as a warning that a severe outbreak of the disease may follow, and the first application of sulphur consequently be made at the relatively high rate of 5 to 6 lb. per acre. It is suggested that dusting programmes should be made more elastic by adjusting them to weather conditions and the elevation of the estate.

KANIVETS (I. I.). **Biochemical methods of creating in soils a resistant texture and their function in the increase of Beet crop yields.**—*Chemisat. socialist. Agric.*, vii, 6, pp. 51–60, 1938. [Russian. Abs. in *Chem. Abstr.*, xxxiii, 19, p. 7941, 1939.]

In experiments in the U.S.S.R. the introduction into the soil of *Trichoderma lignorum* was found to strengthen the texture, increase the moisture content, and improve the nutritional condition and aerial development of plants. The sugar beet, wheat, and oats yields were augmented, with a rise in the sugar content of the first-named of 0.5 to 1 per cent. *T. lignorum* further stimulates the growth of *Azotobacter*. These beneficial effects were intensified by the simultaneous incorporation in the soil of *Aspergillus niger*.

POWERS (W. L.). **Boron as a fertilizer for Western Oregon soils.**—*Science*, N.S., xc, 2324, pp. 36–37, 1939.

Recent experiments by the author in Oregon showed that yellow top of lucerne could be controlled and yield strikingly increased on various soils by applications of boric acid at the rate of 30 lb. an acre [*R.A.M.*, xvii, p. 398]. Similar treatment [amount unspecified] also controlled the nutritional deficiency diseases surface canker of table beets [cf. *ibid.*, xvii, p. 718] and stem crack of celery [*ibid.*, xvi, p. 792]. Boron applications to soil around aster [*Callistephus chinensis*], broccoli, and cabbage plants showing bronzing of the tops and cracking at the nodes have given promising results. The beneficial effects of boron on various plants are indicated.

WARE (W. M.). **The nettlehead disease of Hops.**—*J. S.-E. agric. Coll., Wye*, xlv, pp. 41–43, 1939.

The measures at present recommended for the control of nettlehead disease of hops [*R.A.M.*, xviii, p. 654] in England consist in grubbing affected hills as soon as possible after the symptoms appear (in any case, in the same season) and taking no cuttings for propagation from any garden in which the disease has occurred. Strains of Fuggle hops free from nettlehead exist at East Malling, and sets would be raised from them if required.

OGILVIE (L.). **The nettlehead disease of Hops in the Bristol Province.**—*J. S.-E. agric. Coll., Wye*, xlv, pp. 44–46, 1939.

Nettlehead disease of hops [see preceding abstract] is stated to be absent from very few hop gardens in Worcestershire and Herefordshire and to cause very heavy loss in many of them. It is found on Early

Bird, Mathon, Bramling, and Fuggle hops. Roguing must be prompt and efficient, apparently healthy stocks on either side of a diseased one must generally be removed in lightly affected gardens, and rejected material must be burnt.

WARE (W. M.) & GLASSCOCK (H. H.). **The downy mildew of the Hop in 1938.**—*J. S.-E. agric. Coll., Wye*, xlv, pp. 54–58, 1939.

In this account of the hop downy mildew [*Pseudoperonospora humuli*: *R.A.M.*, xvii, p. 838] situation in England in 1938, it is stated that no great damage was caused. This was probably largely due to the weather conditions, the season 1938 being the seventh consecutive one in which rainfall did not exceed the normal in both July and August, while in June the rainfall was subnormal. Where leaf infections occur at more than 2 ft. from the ground in spite of thorough 'spiking', the plants should be sprayed with Bordeaux mixture (5–7½–100) to protect the remaining pairs of leaves near the growing point. As spraying cannot protect the growing point itself, and does not prevent infection of the terminal spikes, all the infected leaves should previously be removed from the bine when this is about 5 ft. high, even if only four pairs of healthy leaves are left near the growing point. During July, the disease was found on wild hops, forming spikes and leaf infections, in three widely separated areas in Aberdeenshire.

RANGASWAMI (S.) & GRIFFITH (A. L.). **A note on the control and eradication of new outbreaks of the spike disease of Sandal (*Santalum album*).**—*Indian For. Rec.*, N.S., *Silviculture*, iii, 7, pp. 263–290, 6 pl., 4 diags., 1939.

In a study on the spike disease of sandal (*Santalum album*) [*R.A.M.*, xviii, p. 138] the approximate size of the vector was found, in experiments with wire mesh cages, to be about 1/20 to 1/4 in. Furthermore it was proved by exposing pot plants to mass infection by [unidentified] insects, collected during the night on sandal foliage, that the disease is insect-borne. The source of infection was found to be limited to diseased trees, masked diseased trees (i.e., trees during the period between infection and manifestation of symptoms), and to insect vectors, and consequently the disease can be controlled by the elimination of the first two sources, their removal automatically preventing the insect vectors from becoming viruliferous. For the eradication of diseased trees poisoning with Atlas tree killer solution [*ibid.*, xvi, p. 710] was found to be more thorough and economical than extraction. As regards masked trees, it was found that when such plants were defoliated the disease appeared in the new leaves.

The recommendations for the control of the disease [which are fully given, together with an exact description of the symptoms, in an appendix for the use of foresters] are summed up as follows. As soon as an outbreak is reported from an area all spiked trees in it should be killed at once by poisoning, all other sandal trees within the area and in a belt from 100 ft. to two furlongs wide round it should be lopped by removing all branches of 2 in. girth or less, and all trees, in which the disease then becomes manifest, killed. These recommendations proved entirely successful in eradicating the disease (as far as can be judged

after the lapse of periods of up to four years) from eight small areas, where the outbreaks were new and only a few trees affected, while in several large areas, where the disease had been allowed to spread for a number of years before control operations were started, it was confined to its original limits and slowly eliminated from the area. On one large experimental area containing 14,200 sandal trees, 6,337 were either killed at once or lopped and then killed, and no spread of the disease to the adjacent areas has been observed. It was shown that even in large blocks of 300 to 400 acres the spread of the disease can be arrested to a very considerable extent in a comparatively short time. It is stated that since the disease started in the North Salem division (about 26 years ago) the area affected enlarged to approximately 99,500 acres and that the annual loss per tree, as calculated by other workers, amounts to about Rs. 1.55 to 5½. It is concluded that the research on the control of spike has been very remunerative, since the average loss averted by the control operations based thereon already amounts to Rs. 21,000 per annum.

RANGASWAMI (S.) & GRIFFITH (A. L.). **Host plants and the spike disease of Sandal.**—*Indian For.*, lxxv, 6, pp. 335-345, 1939.

When sandal [*Santalum album*] plants growing in pots with any of the 27 hosts tested were artificially infected with spike disease [*R.A.M.*, xviii, p. 343, and preceding abstract] by the standard leaf-grafting method it appeared that the incidence of spike was nil in plants growing on certain hosts (e.g., *Azadirachta indica*, *Strychnos nux vomica*, *Dalbergia sissoo*, and five others), and varied from very low (e.g., *D. latifolia*) to complete incidence (e.g., pigeon pea and *Melia azedarach*) in others. These results indicate that some host plants impart a high degree of relative resistance to spike to sandal plants parasitic on them. This conclusion was confirmed when sandal plants grown on 26 different hosts [which are listed] were exposed to natural infection in the forest. In one small-scale experiment, subplots of one acre, each containing 200 sandal plants, were treated by removing (a) all except resistant hosts and introducing other resistance-imparting species, and (b) all except susceptible hosts and supplementing these by similarly susceptible species. After six years the incidence of spike in the treated areas was in the proportion of 1:4. In a further experiment with five-acre subplots treatment as for (a) and (b) was supplemented by an untreated control plot (c). After seven years spike occurred in the proportion of 0:32:12. It is concluded from these results that the use of resistance-inducing as well as economically profitable hosts of sandal in new plantations should prove of great practical value in reducing the incidence of spike.

SYDOW (H.). **Beschreibungen neuer südafrikanischer Pilze—VII.** [Descriptions of new South African fungi—VII.]—*Ann. mycol.*, Berl., xxxvii, 3, pp. 181-196, 1939.

Latin and German diagnoses are given of seven new species of fungi collected in South Africa [cf. *R.A.M.*, xiv, p. 793], including *Pseudothyridaria moroides*, forming isolated, narrowly striate, longitudinal, tapering weals or galls, up to 13 mm. long, on living twigs of *Rubus pinnatus*; and *Diatrypella agaves* on dying peduncles of *Agave americana*.

SYDOW (H.). **Novae fungorum species—XXVII.** [New species of fungi—XXVII.]—*Ann. mycol., Berl.*, xxxvii, 3, pp. 197–253, 1939.

In this further list [cf. *R.A.M.*, xviii, p. 56] of 45 new species of fungi (mostly from Africa) are included Latin and English diagnoses of three collected by F. C. Deighton in Sierra Leone, viz., *Balladynella palmicola*, occurring on greyish-green, occasionally yellow to brownish, scattered, elliptical or irregular lesions, up to 10 by 8 mm., on living leaves of oil palm, *Mycosphaerella spilota* on living or withered foliage of *Andropogon tectorum*, and *Asterina manihotis* on the foliage of *Manihot glaziovii*.

VERPLANCKE (G.). **Note sur quelques Ascomycètes nouveaux pour la flore belge.** [A note on some Ascomycetes new for the Belgian flora.]—*Bull. Jard. bot. Brux.*, xv, 3, pp. 333–344, 1939.

An annotated list is given of 25 Ascomycetes new to the Belgian flora, from herbaria of the Botanical Gardens, Brussels. *Sphaerella* [*Mycosphaerella*] *sentina* on pear leaves is transferred to *Phaeosphaerella* as *P. sentina* n. comb.

WEST (E.). **Notes on Florida fungi.**—*Mycologia*, xxxi, 4, pp. 423–432, 3 figs., 1939.

This is an annotated list of 20 fungi collected in Florida, including *Uromyces indigoferae* on *Indigofera tinctoria* and *I. suffruticosa*, believed to be recorded for the first time from the United States.

GARRETT (O. A.). **The Ustilaginales or smuts of Utah.**—*Bull. Utah Univ., Biol. Ser.*, iv, 4, 23 pp., 4 pl., 1939.

This is an annotated list of 42 smuts collected (mostly by the author) in Utah since 1902. Keys to the families and genera and fungus and host indexes are provided.

MIX (A. J.). **Mycelial habit in some species of Taphrina.**—*Mycologia*, xxxi, 4, pp. 445–454, 2 figs., 1939.

Eight species of *Taphrina* [*R.A.M.*, xviii, p. 141] parasitic on ferns or monocotyledons, including two new to science, were found to form mycelium within the outer wall of the epidermal cell of the host, and to produce ascogenous cells and asci in a locule of the epidermal wall.

GROVES (J. W.) & DRAYTON (F. L.). **The perfect stage of Botrytis cinerea.**—*Mycologia*, xxxi, 4, pp. 485–489, 1 fig., 1939.

About 70 isolates of *Botrytis cinerea* from various hosts and localities were used in attempts to obtain a perfect stage of the fungus. The technique used was the same as that previously described by Drayton [*R.A.M.*, xvi, p. 750], but the spermatization was achieved by applying the spermatial suspension directly to the sclerotia or to sterilized soil, which was then placed over the sclerotia; the process was delayed for a fortnight after moving the cultures from 0° to 5° C. and they were then kept at 14° for one month prior to their transfer to the greenhouse. Mature apothecia were obtained in nine out of 16 isolates from apples, celery, or potato stems, the first being found about a fortnight after the cultures were moved to the greenhouse and many more developing during

the following six weeks. In single ascospore cultures obtained from these nine isolates very marked differences existed in the rate of growth, sclerotial production, and general appearance. In most cases the cultures which did not produce sclerotia developed abundant spermatia, but all sclerotia-producing cultures formed spermatia as well. No explanation of these variations has yet been found, but it is possible that more than one species was involved. Hence no change in nomenclature is proposed for the present, and it is hoped that the work now in progress with single ascospore cultures will help to interpret the variations observed and to clarify the species concept in this group of fungi.

SAMPSON (KATHLEEN). *Olpidium brassicae* (Wor.) Dang. and its connection with *Asterocystis radialis* de Wildeman.—*Trans. Brit. mycol. Soc.*, xxiii, 2, pp. 199–205, 1 pl., 1 fig., 1939.

From a study of a species of *Olpidium* with stellate cysts found on the roots of *Agrostis* [in Wales] and later obtained from cauliflower seedlings raised in infected soil, of *O. brassicae* from cabbage [from England], and of material supplied by A. W. Bartlett of *O. radiculicolum* [*R.A.M.*, viii, p. 282; ix, p. 288] on swedes, the author concludes that all these organisms are identical with *O. brassicae* [*ibid.*, xviii, pp. 139, 483]. Comparison with published records led to the further conclusion that the following species are synonyms: *Asterocystis radialis* [*ibid.*, xviii, p. 550], *O. borzii*, *O. radiculicolum*, and *Olpidiaster radialis* [*ibid.*, viii, p. 282; xvii, p. 415]. A revised description of the fungus is given. The zoosporangia are solitary or aggregated in the host cell, thin-walled, varying from spherical, 12 to 20 μ in diameter, to elongate, 25 to 220 by 20 to 45 μ , opening by one to four exit tubes which vary in length according to the distance from the host surface. The zoospores, 3 μ in diameter, are uniciliate. The resting sporangia (cysts) are usually spherical, 8 to 25 μ in diameter, but may be oval, up to 30 μ in length. The exospore is coarsely wrinkled with ridges up to 3.5 μ in height, showing a stellate form with six to nine points in optical section. The endospore is thin and smooth, free from the exospore.

HILBORN (M. T.) & LINDER (D. H.). The synonymy of *Fomes fomentarius*.—*Mycologia*, xxxi, 4, pp. 418–419, 1939.

A list is given of 21 generally accepted synonyms and 5 suspected synonyms of *Fomes fomentarius* (Fries) Kickx, a fungus frequently but incorrectly cited as *F. fomentarius* (L.) Gill.

SUBBA RAO (M. K.). Report of the Mycologist, 1937–38. Report of the Mycologist, 1938–39.—*Adm. Rep. Tea sci. Dep. unit. Plant. Ass. S. India*, 1937–38, pp. 28–37, 1938; 1938–39, pp. 28–42, 1939.

In the first of these reports [cf. *R.A.M.*, xvii, p. 138] it is stated that the leaf disease of tea caused by *Cercospora theae* [*ibid.*, xvii, p. 706], first reported from southern India in 1935, became more prevalent in that area in 1937–8, occurring on many estates in the Nilgiris, Wynaads, the Anamallais, and the High Range. The severity of the outbreak appears to have been influenced by the previous condition of the bushes, weak bushes having suffered more than healthy ones. The fungus was also recorded on *Acacia decurrens*, to the foliage of which

it caused much damage, *Albizzia moluccana*, *Poinciana regia*, and *Aleurites* spp.

Only a few inquiries regarding *Corticium invisum* [ibid., xvii, p. 138] were received. Tea leaves are frequently infected by *Asterina camelliae* [ibid., xvii, p. 162], which parasitizes the leaf superficially but does not cause much damage. All the affected leaves examined showed the presence of *Dimerium wattii* parasitizing *A. camelliae*.

Leaf fall of *Grevillea [robusta]*, associated with a *Pestalozzia* and a *Phyllosticta* [cf. ibid., xviii, p. 713], was noted on some estates in the Nilgiri-Wynaad, the chief feature being defoliation of the growing shoot, while the older leaves were not much affected. The similarity of the *Phyllosticta* with that associated with leaf fall of *G. robusta* in Ceylon was confirmed by C. H. Gadd.

Cardamom [*Elettaria cardamomum*] is locally affected by mosaic [ibid., xviii, p. 89], and during the period under review was attacked by a rhizome rot associated with *Rhizoctonia [Corticium] solani* and eel-worm (probably *Anguillulina*), the plants showing a damping-off effect, with most of the aerial growth collapsing at ground-level.

In the second report it is stated that tea black blight (*Asterina camelliae*) appeared to have spread in 1938-9 to areas previously unaffected. The fungus was observed to attack bushes towards the end of the pruning cycle and during the rainy season; in the subsequent dry weather none of the affected bushes showed any serious after-effects.

Tea die-back and canker is constantly associated with *Nectria subquaternata*, which is regarded as the cause of the disease, though inoculations with this fungus were unsuccessful. Affected branches show numerous gnarled cankers along their length, continuously or in patches, while the bark turns dirty brown, and is ruptured on the surface. Finally the leaves die. The symptoms are most evident in dry weather. The branches attacked are not thicker than a pencil, and both green shoots and red wood are susceptible. Generally injury seems to begin at leaf scars, but infection may start at wounds caused by plucking or tipping, or at branch axils. The cankered areas are weak, and infected shoots, when dry, break off readily. A conidial form, definitely established as belonging to *N. subquaternata*, appeared on the diseased shoots after the beginning of the rains. Descriptions are given of both stages of the fungus.

Die-back of tea shoots and pruned branches due to *Megalonectria pseudotrichia* and its conidial form *Stilbum cinnabarinum* [ibid., xvii, p. 299] caused slight damage. It is recommended that the affected shoots should be cut back to the new wood.

Die-back of tea shoots after pruning, due to *Leptothyrium theae* [ibid., xv, p. 747], was first observed in southern India in April, 1938, on an estate in the High Ranges, and since that date has been found in the Vandiperiyar District and South Travancore. The fungus attacks young shoots that develop after pruning, the foliage becoming yellow and gradually turning brown and dying; green shoots also turn brown. The disease is not at present serious, but may become more important if uncontrolled.

The leaf fall of *G. robusta* referred to in the earlier of these reports was recorded during 1938-9 at an altitude of nearly 4,500 ft., though

until recently confined to the lower elevations. This rapid spread caused alarm on estates where shade presents a difficult problem. Incidence has been severe. Australian authorities, upon being consulted, stated that in Australia the disease occurs in forest nurseries, but can be controlled by two applications of Bordeaux mixture (3-4-40) applied at an interval of a fortnight.

Hevea rubber mildew [*Oidium heveae*: *ibid.*, xviii, p. 500] was recorded in southern India in 1936-7, and appears to be spreading to new areas.

KUNKEL (L. O.). **Movement of Tobacco-mosaic virus in Tomato plants.**

—*Phytopathology*, xxix, 8, pp. 684-700, 2 figs., 1939.

In experiments at the Rockefeller Institute for Medical Research, 44 hours was the minimum period for the initiation of the movement of the tobacco mosaic virus out of inoculated Bonny Best tomato leaflets. On first reaching the stem, the virus generally moved both upwards and downwards, though occasionally its passage was in one direction only. No evidence was forthcoming that the virus traverses the roots on its way from an inoculated leaf to the tip of the plant, and in certain individuals, at any rate, this course was definitely not followed. Once movement from an infected leaflet begins the virus travels rapidly, covering a distance of 7 in. or more per hour in some cases. Samuel's observation that in the first stages of entry into the stem the virus particles may be separated by considerable distances [*R.A.M.*, xiii, p. 476] was fully confirmed by these experiments. The particles have to pass through long chains of cells before infection is established, so that propagation by means of an autocatalytic reaction cannot be involved in this process. Virus particles, after remaining for some time in a dormant condition in sections of tobacco or tomato stems, may move out into plants arising from such sections and there multiply and cause infection. Observations on the development of mosaic in a plant of *Abutilon striatum* [*ibid.*, xvi, p. 130] after an apparent cure persisting for seven months suggest that in rare instances particles of this virus may also lie dormant in the plant.

WALLACE (J. M.). **Recovery from and acquired tolerance of curly top in *Nicotiana tabacum*.**—*Phytopathology*, xxix, 8, pp. 743-749, 4 figs., 1939.

In this expanded account of the writer's experimental observations in California on the recovery of Turkish tobacco from beet curly top and the acquisition by the host of tolerance of the virus [*R.A.M.*, xviii, p. 142], it is stated that the infective principle was detected in recovered plants of the fourth vegetative generation. The phenomena of recovery and acquired tolerance in tobacco affected by curly top are comparable in many ways to those reported for tobacco ring spot [*ibid.*, xv, p. 831] and tomato curly top [*ibid.*, xviii, p. 64], and it is suggested that such material affords an excellent opportunity for the study of immunology in plants.

KOCH (L. W.). **The present status of the Tobacco root rot problems in Ontario.**—*Lighter (Dep. Agric., Can.)*, ix, 3, pp. 18-20, 1939. [Mimeographed.]

Brown root rot of tobacco in Ontario [*R.A.M.*, xvi, p. 637; xvii,

p. 774], which is attributed to a toxin or toxins, perhaps in association with micro-organisms, differs in some important particulars from the disease given the same name in the United States [ibid., xviii, p. 715]. In Ontario, the disease is most prevalent and severe on the light, sandy soils of Essex County, and the most extensive injury has consistently been noted on Burley tobacco, though damage also occurs on flue-cured and dark tobaccos. The condition may be materially reduced in the flue-cured crop by growing the more resistant varieties, such as White Mammoth, Bonanza, or Duquesne, provided that black root rot (*Thielaviopsis basicola*) is not also present, or in the Burley crop (with the same proviso) by growing Kelley or Judy's Pride. Brown root rot has consistently caused the greatest amount of damage when maize or soy-bean immediately preceded tobacco in the rotation. When other conditions favour the disease, it often varies in direct proportion to the number of successive crops of maize or soy-bean preceding the tobacco.

While true resistance to *T. basicola* is not shown by any flue-cured tobacco in Ontario, Yellow Mammoth and a strain of Gold Dollar show a considerable degree of resistance; so far, Harrow Velvet has proved to be the only resistant Burley variety, and has been found very satisfactory in other respects. The evidence indicates that the longer the rotation the greater the freedom from *T. basicola*, provided that the intervening crops are not hosts of the fungus. Under ordinary conditions, a four-year rotation on the lighter soils has satisfactorily checked damage from *T. basicola* on susceptible varieties.

PORTE (W. S.), DOOLITTLE (S. P.), & WELLMAN (F. L.). **Hybridization of a mosaic-tolerant, wilt-resistant *Lycopersicon hirsutum* with *Lycopersicon esculentum*.**—*Phytopathology*, xxix, 8, pp. 757-759, 1 fig., 1939.

The wild South American *Lycopersicon hirsutum* has been found to be highly resistant to wilt (*Fusarium bulbigenum* var. *lycopersici*) [see above, p. 788] and apparently completely tolerant of tobacco mosaic, the latter character not having previously been observed in any of the *L.* species on varieties tested by the writers. Crosses between the species and Marglobe and Bonny Best tomatoes have been made and are being developed.

BLOOD (H. L.). **Breeding technique for disease-resistant Tomatoes. Study of suitable varieties for Pacific Coast and Intermountain State.**—*West. Cann. Pack.*, xxxi, 2, p. 50, 1939. **Breeding disease-resistant Tomato varieties for the Intermountain States and the Pacific Coast.**—*Nat. Cann. Ass.*, Wash., 2 pp., 1939 [mimeographed]. **Breeding disease resistant Tomato varieties. 2. For the Intermountain States and Pacific Coast.**—*Canner*, lxxxviii, 12, pp. 87-88, 1939. [Abs. in *Plant Breed. Abstr.*, ix, 4, p. 477, 1939.]

Resistance to curly top is stated to have been shown by about 19 tomato [*R.A.M.*, xv, p. 123] selections (including the green-fruited *Lycopersicon hirsutum*) of South American, Mexican, and hybrid origin in trials in Utah, where an intensive breeding programme has been planned to transfer this character to commercial varieties. Another green-fruited species from South America, *L. peruvianum*, is highly

resistant to *Fusarium* [*bulbigenum*] var. *lycopersici* [see preceding abstract]. A certain degree of resistance to wilt (*Verticillium*) [*albo-atrum*] has been incorporated in the Californian-bred Riverside tomato [*ibid.*, xvii, p. 139], while the same quality in a very pronounced form is typical of a Peruvian wild strain which is also being used in breeding experiments. Forms combining resistance to spotted wilt [*ibid.*, xviii, p. 439] with desirable commercial qualities have been obtained by D. W. Porter in the F_2 of the cross *L. pimpinellifolium* \times Marglobe. Resistance to mosaic has not yet been developed to any noteworthy extent.

D'OLIVEIRA (MARIA DE L.). **Inoculações experimentais com o Bacterium savastanoi E. F. Smith e o Bacterium savastanoi var. fraxini N. A. Brown.** [Experimental inoculations with *Bacterium savastanoi* E. F. Smith and *Bacterium savastanoi* var. *fraxini* N. A. Brown.]—*Agron. lusit.*, i, 1, pp. 88–102, 2 pl., 1939. [English summary.]

A tabulated account is given of cross-inoculation experiments at the Botany School, Cambridge, and the Almeida Phytopathological Laboratory, Lisbon, with *Bacterium* [*Pseudomonas*] *savastanoi*, isolated from olives in Portugal, and *Bact. savastanoi* var. *fraxini* [*P. fraxini*: *R.A.M.*, xviii, p. 560] from ash in the Cambridge district. The former was found to be much more active than the latter outside its natural host, inducing typical galls on *Forsythia viridissima*, *F. intermedia*, and *Fraxinus angustifolia*, and rough overgrowths arising from cell proliferation along the veins of *Phillyrea media* leaves. The ash organism, on the other hand, failed to produce true cankers on plants outside the genus *Fraxinus*, though it caused slight necrosis on olives, persistent necrosis, sometimes accompanied by girdling, of *Forsythia intermedia* twigs, and moist scabs on privet (*Ligustrum japonicum*), *F. viridissima*, and *F. suspensa*. It would thus appear that both the organisms under observation tend to produce the same type of infection as on the original hosts.

The ash trees referred to above also developed proliferating cankers from which was isolated a fungus identified by J. Ehrlich as *Cylindrocarpum mali* or its var. *flavum* [*Nectria galligena* or its var. *major*: *ibid.*, vii, p. 677].

DAY (W. R.). **Root-rot of Sweet Chestnut and Beech caused by species of Phytophthora. II. Inoculation experiments and methods of control.**—*Forestry*, xiii, 1, pp. 46–58, 1939.

In continuation of his studies on the root rot disease of sweet chestnut and beech [*R.A.M.*, xviii, pp. 282, 355], the author demonstrated in inoculation experiments from 1932 to 1937 that these trees and *Castanea crenata* (a species not grown in Great Britain, but reported as highly resistant to root rot from France and elsewhere), are all susceptible to *Phytophthora cambivora*, *P. syringae*, and *P. cinnamomi*, *C. crenata* and beech being rather less susceptible than sweet chestnut to *P. cinnamomi*, while *C. crenata* is possibly the more resistant to *P. syringae*. Field observations indicated that beech is more resistant to both *P. cambivora* and *P. cinnamomi* than sweet chestnut. Oak trees,

though successfully inoculated, were only slightly affected by *P. cambivora*, while elm and *Nothofagus* spp. were both susceptible to attacks by this species. Plants of *C. crenata* raised for trial purposes were found to suffer from frost injury; their resistance to root rot is not yet known in the field.

The control of *Phytophthora* root rot in Great Britain is considered to depend mainly on the avoidance of heavy water-retentive or badly drained soils. Sweet chestnut should preferably be planted on light, well-drained, non-calcareous loams of at least moderate fertility, and beeches on dry heavy soils, such as are commonly derived from clay with flints overlaying chalk. The excision of diseased bark and sterilization of the wound and of the soil may save individual trees in an early stage of infection.

ARNAUD (G.). **La résistance des Ormes à la maladie (*Graphium ulmi*).**

[The resistance of Elms to the disease (*Graphium ulmi*).]—*Ann. Épiphyt.*, N.S., v, 1, pp. 41–49, 2 figs., 1 map, 1939.

Observations at Versailles on 50 young elms of the *Ulmus campestris* type planted in a locality where infection by *Ceratostomella ulmi* [*R.A.M.*, xviii, p. 771] was abundantly present showed that after ten years only two were unaffected. Vigorous trees suffered most. Trees from which the top diseased part of the trunk had been removed remained healthy for a time and sprouted vigorously, but became reinfected in equal proportion to trees infected for the first time. There was no evidence of immunization.

Some objections to the view that the disease is spread by *Scolytus* beetles [*S. scolytus* and *S. multistriatus*: *ibid.*, xviii, p. 557] are brought forward. For example, no damage by these insects was observed on young trees, some of which rapidly became infected. Adult insects were on several occasions observed in a small gallery at the base of healthy branches. A striking disparity was noted between the very large numbers of insects emerging from dead and diseased trees and the few trees that became infected each year. Further, no insects are associated with the closely similar disease caused on *Ailanthus glandulosa* in Paris by *Verticillium dahliae* [*ibid.*, xvii, p. 493].

BUCHWALD (N. F.). **Douglasiens Sodskimmel (*Phaeocryptopus gäumannii*). En ny svamp paa Douglasgran i Danmark.** [The Douglas Fir soot fungus (*Phaeocryptopus gaeumanni*). A new fungus on Douglas Fir in Denmark.]—*Dansk Skovforen. Tidsskr.*, 1939, pp. 357–382, 12 figs., 1939.

An account is given of the symptomatology, morphological characters, taxonomy, course of infection, geographical distribution, origin, and control of *Phaeocryptopus gaeumanni*, first observed on Douglas firs (*Pseudotsuga taxifolia*) [*R.A.M.*, xviii, p. 490] in Denmark in May, 1938; the disease has now been definitely reported from three localities in Zealand and Jutland, trees up to 35 years old being attacked. All three types of the fir—blue (var. *glauca*), grey (var. *caesia*), and green (var. *viridis*)—were involved, but generally speaking, the two first (inland) are much more susceptible than the last-named (maritime). The fungus is believed to have been conveyed to Denmark from England

by the wind; the latter country and Switzerland appear to have acted as the two centres of dissemination in Europe. Appropriate measures have already been adopted in Germany for the gradual replacement of the susceptible blue and grey types by the resistant green, and a similar course should probably be pursued in Denmark.

PEACE (T. R.). **Forest pathology in North America.**—*Forestry*, xiii, 1, pp. 36-45, 1939.

This is a general survey of problems confronting forest pathologists in North America, based on a four months' tour, in the course of which the author visited 36 American States and three Canadian provinces. In contrast to the predominantly artificial and pure forests of Great Britain, the American forests are stated to be primarily natural and usually mixed. Minor diseases of young trees are of little importance, but more serious are the epidemic diseases such as *Endothia parasitica* and *Cronartium ribicola*. The greatest immediate danger to American forests is decay, which is causing very high losses among the old trees in the west and among the second- and third-growth hardwoods arisen from seeds or as sprouts from the old stumps in the east, often entering the trees through the wounds caused by surface fires. *Fomes annosus* [*R.A.M.*, xvii, p. 714; xviii, pp. 74, 357] occurs commonly but is not associated with any considerable damage. *Rhabdocline pseudotsugae* [*ibid.*, xviii, p. 491] has so far proved less serious to the Douglas fir (*Pseudotsuga taxifolia*) than in Europe; there are several varieties of the fungus in America varying in the form of fructifications and spores, and probably in pathogenicity. *Adelopus* [*Phaeocryptopus*] *gaeumanni* [see preceding abstract] occurs on the same host over a large area in north-west America but does not cause appreciable injury to the trees. Variation in the Douglas fir is so great that a uniform type of growth or resistance to disease cannot be obtained from seeds collected in any one State or any one forest. Selection of desirable types carried out on individual trees or on very small areas should prove very valuable. *Hypodermella laricis* [*ibid.*, xii, p. 255], common on larch in British Columbia and Idaho, is not considered a serious disease in America but might prove troublesome if brought to Europe. What was apparently a particularly severe and general attack of *Gnomonia veneta* [*ibid.*, xviii, p. 354] on planes [*Platanus*] was experienced during 1938, being particularly conspicuous in some of the river valleys near the Californian coast, where most of the trees were completely defoliated in mid-May. The attacks of this fungus in Great Britain are never so severe and extensive, the same applying to *Physalospora miyabeana* [*ibid.*, xiv, p. 479] and *Fusicladium saliciperdu* [*loc. cit.*], both of which caused a serious defoliation and die-back of willows in New England. The number of canker-forming fungi occurring in America is much larger than in Great Britain, and the American situation in this respect is much more serious. The less important are *Phomopsis lokoyae* [*ibid.*, xiii, p. 200] on Douglas fir, *Aleurodiscus amorphus* [*ibid.*, xiii, p. 608] and *Cephalosporium* sp. on *Abies* [*ibid.*, xvi, p. 847], *Cytospora* sp. on spruce and poplar [*ibid.*, xviii, p. 354], *Tympanis* sp. on pine [*ibid.*, xviii, p. 217], and *Caliciopsis pinea* on pine [*ibid.*, xv, p. 760], none of which occurs on trees in really good condition, while the *Nectria*

canker [ibid., xviii, p. 354] is both widespread and serious in the East.

With regard to quarantine legislation the author is inclined to think that periodical inspection and licence of the nurseries where export stocks are grown, and above all the selection and breeding of resistant strains, will do more in future to ensure the adequate protection of forests than the enforcing of new and stricter quarantine rules.

THOMPSON (G. E.). **A canker disease of Poplars caused by a species of *Neofabraea*.**—*Mycologia*, xxxi, 4, pp. 455-465, 3 figs., 1939.

Isolations from cankers on three- to six-year-old trees of *Populus grandidentata*, *P. tacamahacca*, and *P. tremuloides* observed in several parts of the Temagami Forest Reserve, Ontario, in 1930 and later, yielded a fungus described [with a Latin diagnosis] as *Neofabraea populi* n.sp. The disease first appears as small, depressed areas in the bark, frequently with a swelling at the margin and a vertical split in the centre of the lesions. Older cankers, ranging from 4 to 6 in. in length, are elliptical, girdling the stem with or without callus formation. In transverse section through a canker the wood is brownish, the discoloration often extending to the pith or some way along the annual rings.

The fungus is described as having mostly single, or some few confluent apothecia, scattered thickly over the dead bark; they are flesh-coloured to light brown and convex when fresh, becoming darker and flat to slightly concave when dry, fleshy to waxy in consistency, circular to irregular in outline, usually umbilicate, borne on a slight stroma about 100 to 150 μ thick, composed of loosely arranged, narrow-oblong to globose, hyaline hyphae, with the excipulum consisting of narrow, brownish, obliquely arranged hyphae; the asci are cylindrical-clavate, short-stalked, 80 to 112 μ by 9.5 to 12.5 μ , and contain eight irregularly biseriate, oblong-ellipsoid, straight to slightly curved, granular, hyaline, uni- to quadricellular ascospores, 16 to 22 by 5 to 6.5 μ ; the paraphyses are filiform, 2 to 3 μ wide, hyaline, septate, simple or branched, slightly swollen at the tips, forming an epithecium. The conidial stage is a species of *Myxosporium* with conidiophores 25 to 35 by 4 μ , bearing cylindric-fusiform, straight or curved, conidia 25 to 45 by 4.5 to 5 μ .

Identical cultures were obtained from isolations of the fungus from ascospores, conidia, and tissue plantings of the diseased bark. The optimum temperature for growth in culture was approximately 18° C., some growth occurring at both 3° and 27°. Both single and poly-ascosporic isolations were found to produce apothecia after about 45 days' growth on maize meal agar at a temperature of 15°. The fungus was successfully inoculated into small trees of *P. grandidentata* and subsequently reisolated in pure culture.

KASAI (M.). **The staining fungus, *Graphium rubrum* Rumbold, on Chinese bandoline wood.**—*Ann. phytopath. Soc. Japan*, viii, 4, pp. 327-330, 3 figs., 1939. [Japanese. Abs. in *Biol. Abstr.*, xiii, 7, p. 1206, 1939.]

Particulars are given of the morphological and cultural characters of *Graphium rubrum* [*R.A.M.*, xiii, p. 555], the agent of a greyish staining of Chinese bandoline wood, *Machilus thunbergii*, this being the first

record both of the occurrence of the fungus in Japan and of its attack on the host in question.

FINDLAY (W. P. K.). **Effect of sap-stain on the properties of timber.**

II. Effect of sap-stain on the decay-resistance of Pine sapwood.—*Forestry*, xiii, 1, pp. 59–67, 1 graph, 1939.

In further studies on blue stain of pine sapwood caused by *Ophiostoma coeruleum* (or *Ceratostomella coerulea*) [*R.A.M.*, xvii, p. 1], it was experimentally found that in most cases both naturally and artificially blue-stained sample blocks of Scots pine and Corsican pine (*Pinus nigra* var. *calabrica*) were more readily attacked by certain wood-destroying fungi (*Merulius lacrymans*, *Coniophora cerebella* [*C. puteana*], and *Poria vaillantii*) [*ibid.*, xviii, p. 644] than clean ones, particularly when the staining fungus was dead. This was apparent from the slightly greater loss in weight from decay incurred in the former. In comparative tests blue-stained wood was found to absorb water more rapidly than clean material, and it is suggested that this greater porosity, which permits more rapid diffusion of the moisture and gases, and also of the enzymes produced by the fungi, may be the reason why the blue-stained wood is more readily attacked. There was no significant difference in the rate of drying of the blue-stained and the clean planks. It is pointed out in conclusion that since all sapwood has a low natural resistance to wood-destroying fungi, slight differences in this resistance are of no practical importance, and that from the point of view of natural durability the presence of blue stain need not be regarded as a serious defect.

BOSE (S. R.). **Enzymes of wood-rotting fungi.**—*Ergebn. Enzymforsch.*, viii, pp. 267–276, 1939.

This is a summary of some outstanding contributions to the knowledge of the enzymatic properties of wood-destroying fungi.

Method of testing the toxicity of wood preservatives to fungi.—*Brit. Engng Stand. Ass. (Comm.) [Rep.]* 838, 17 pp., 2 diags., 1939.

Detailed directions are given for testing the toxicity of timber preservatives by the standard wood block method (recommended for adoption as the standard British method) [*R.A.M.*, xvii, p. 283 *et passim*], using *Coniophora cerebella* [*C. puteana*] (Idaweiche strain), *Lentinus lepideus*, and *Poria vaporaria* (Eberswalde strain) for trials on Scots pine sapwood and *Polystictus versicolor* for those on the outer wood of beech. In a test cited as an example of the evaluation of results, the toxic limits (toxic points), i.e., the interval between the concentration just permitting decay and that next highest in the series completely inhibiting it, for creosote (British Specifications type A) [*ibid.*, xvi, p. 788] are given as 4 to 6, 4 to 8, about 12, and about 5 kg. per cu. m. for *C. puteana*, *Poria vaporaria*, *L. lepideus*, and *Polystictus versicolor*, respectively, the corresponding figures for sodium fluoride (excluding *P. versicolor*) being 0.5 to 0.7, 0.2 to 0.4, and about 0.1, respectively. Tested against *C. puteana*, 0.06 and 0.08 per cent. sodium fluoride preserved pine sapwood in a sound condition for four months at 22° C.

(the former concentration allowing slight superficial fungal growth), at 0.04 incipient decay set in (4.7 per cent. loss of dry weight), while the blocks in the 0.02 and control series were completely rotted (42 and 49.5 per cent. loss of weight, respectively).

DREFAHL (L. C.) & BESCHER (R. H.). **The effect of sodium dichromate on the preservative value of zinc chloride.**—*Proc. Amer. Wood Pres. Ass.*, xxxv, pp. 30–53, 5 graphs, 1939.

A full account is given of laboratory and outdoor service experiments in the control of the wood-destroying fungi *Coniophora cerebella* [*C. puteana*], *Lentinus lepideus*, and *Lenzites sepiaria* on southern yellow pine [*Pinus ponderosa*], Douglas fir [*Pseudotsuga taxifolia*], red oak [*Quercus* spp.], and gum [*Liquidambar styraciflua*] with a combination of zinc chloride (81.5 per cent.) and sodium dichromate (18.5 per cent.), wood being impregnated with this mixture at the rate of $\frac{3}{4}$ lb. per cu. ft. The results of the tests indicated that the combined treatment confers greater resistance to leaching, leaves a more toxic residue in leached wood, and extends the duration of serviceability in accelerated outdoor tests as compared with zinc chloride alone. Preservative methods are practically the same as for the latter, except that the temperature of the solution should not exceed 160° F. Corrosion was found to be materially reduced, both in respect of treating-plant equipment and hardware affixed to treated wood, by the use of the mixture instead of zinc chloride alone.

BRYAN (J.). **A new preservative.**—*Wood, Lond.*, iv, 4, pp. 161–162, 1939.

The admixture with a 1 per cent. solution of mercuric chloride of 2 per cent. potassium dichromate was shown in tests extending over a year at the Forest Products Research Laboratory, Princes Risborough, to reduce leaching to a negligible minimum without adversely affecting the toxicity of the former compound to *Lentinus lepideus* on Scots pine [*R.A.M.*, xviii, p. 426]. The further addition of sodium nitrite at the rate of 5 per cent. prevented the corrosion of metal containers. In order to obviate the reduction of the dichromate by the nitrite, it is necessary to adjust the solution to an alkaline reaction by the incorporation of 0.5 per cent. caustic soda.

BERTLEFF (V.). **Prüfung arsenhaltiger Holzschutzmittel.** [The testing of arsenic-containing wood preservatives.]—*Holz Roh- u. Werkstoff*, ii, 5, pp. 193–197, 3 figs., 1939.

A tabulated account is given of the writer's tests by the wood block (spruce and pine) method at Žilina, Czechoslovakia, of a new timber preservative, fluoran O. G. (Verein für chemische und metallurgische Produktion, Aussig a.d. E.), containing sodium fluoride, potassium dichromate, dinitrophenol, and sodium arsenate. The preparation does not corrode iron and conferred adequate protection against infection by various fungi at a concentration of 1 to 1.5 per cent. For practical purposes the use of a 2 per cent. solution (6 kg. per cu. m. pine wood) under vacuum may be recommended.

DAHLBERG (H. W.). **New Great Western leaf spot resistant varieties.**—*Proc. Amer. Soc. Sug. Beet Technol.*, 1939, pp. 29–30, 1939 [Abs. in *Facts ab. Sug.*, xxxiv, 9, p. 55, 1939.]

Two new Great Western sugar beet selections, X Gr. 3719 and X Gr. 3720, demonstrated a very high degree of resistance to leaf spot [*Cercospora beticola*: see above, p. 777] in Colorado in 1938, when the disease was more severe than at any time during the preceding ten years, reaching a climax between 21st and 28th September.

NOLL (W.). **Untersuchungen über Fuss- und Welkekrankheiten bei Leguminosen.** [Studies on foot and wilt diseases in Leguminosae.]—*Z. PflKrankh.*, xlix, 6, pp. 385–431, 16 figs., 1939.

A detailed, tabulated account is given of the writer's studies at the Bonn Phytopathological Institute from 1935 to 1937 on the wilts and foot rots of Leguminosae, the material for examination being procured from various parts of Germany, supplemented by samples from Denmark and Holland. Garden and field peas affected by foot rot with occasional wilting yielded in pure culture on oatmeal or cherry agar *Ascochyta pinodella* [*R.A.M.*, xv, p. 273] (isolated 215 times out of 257 samples), *Mycosphaerella pinodes* [*ibid.*, xviii, p. 237] (32), *Fusarium avenaceum* [*ibid.*, xviii, p. 154] (25), *F. solani* (18), *F. oxysporum* [*ibid.*, xiii, p. 613] (13), *Rhizoctonia* [*Corticium*] *solani* [*ibid.*, xvii, p. 645] (12), and a number of other fungi (5 times or less). This form of the disease totally destroyed a pea stand at Odense, Denmark, in 1936, while infection percentages of 50 and 80 were observed in Württemberg and the Rhine Province, respectively. In a Rhenish field presenting quite a sound external appearance in 1937, 37 out of 89 plants in a row were found to be diseased; their average height was 40 cm. compared with 80 cm. for their healthy neighbours, which also bore five pods 6 to 7 cm. in length as against one or two of 4 to 6 cm. in the case of the infected material. Another form of foot rot, associated with conspicuous midsummer wilting, was found to be predominantly due to *F. spp.*, especially *F. solani* (isolated 46 times from one lot and 66 from another), *C. solani* (12 and 14), and *A. pinodella* (16 and 6). From 27 samples of pea plants affected by wilting of the central cylinder without foot rot *F. solani* was isolated 16 times, *C. solani* 8, *P. de Baryanum* 7, and *A. pinodella* once.

C. solani and *P. de Baryanum* were each isolated three times and *F. avenaceum* once from Dutch broad beans (*Vicia faba*) showing foot rot symptoms without wilt. Ten samples from Bonn (1936) yielded *C. solani* ten times, *F. orthoceras* four, and *F. avenaceum* three, while from twelve from the same locality (1937) *F. oxysporum* was isolated ten times, *P. de Baryanum* three, and *F. avenaceum* and *Calonectria graminicola* var. *neglecta* once each. The results of further tests on 52 German samples indicated that *Corticium solani*, *P. de Baryanum*, and *F. orthoceras* are much more prominent on the root system than at the stem base; the latter site yielded *A. pinodella* in five instances, *F. solani* in eight, and *Calonectria graminicola* var. *neglecta* in seven.

Twenty German samples of vetches gave rise in eight isolations to *F. oxysporum*, in seven to *F. avenaceum*, while *C. graminicola* var. *neglecta*

and *Corticium solani* developed six times each; *Vicia narbonensis* was infected by *C. solani* and *F. orthoceras* (five each).

Of two consignments of diseased (combined wilt and foot rot) lupin (*Lupinus angustifolius*) material from Bonn (1936 and 1937), the former yielded predominantly *C. solani* [ibid., xviii, p. 116] and the latter *F. oxysporum* [loc. cit.]. Isolations from 97 samples of tap-roots and stem bases of diverse origin included *F. oxysporum*, *P. de Baryanum*, *C. solani*, *F. solani*, *F. avenaceum*, and *A. pinodella* (27, 22, 21, 18, 11, and 9 times), besides other *F. spp.* and miscellaneous fungi.

From 29 samples of soy-bean plants killed by wilt and foot rot near Cologne in 1937 *F. oxysporum* was isolated 27 times; other fungi implicated in the disease included *C. solani*, various species of *Fusarium*, and *A. pinodella*.

Inoculation experiments were carried out with *A. pinodella*, *M. pinodes*, *A. pisi* [ibid., xvii, pp. 427, 432] (for comparative purposes), *Corticium solani*, *F. solani*, *F. oxysporum*, *F. orthoceras*, and an unidentified *F. sp.* from *L. luteus*, the inoculum being introduced into the soil, while in the case of *A. pinodella* the plants were also sprayed with conidial suspensions and the seed was immersed in these for 24 hours before planting. All three strains of *A. pinodella* (from peas, broad beans, and soy-beans) were pathogenic to the same three hosts, peas being uniformly the most severely infected and soy-beans the least. In another test on garden peas, strains from field peas, broad beans, *L. angustifolius*, and soy-beans were equally virulent. Similar, though less extensive, injuries were produced by *M. pinodes* in cross-inoculations on peas (garden and field), *L. angustifolius*, *L. luteus*, broad beans, and *V. villosa*. *A. pisi*, on the other hand, was practically innocuous to peas.

Most of the legume strains of *C. solani* were highly pathogenic to their own hosts and the other test plants, those from pea, *L. angustifolius*, and *V. narbonensis* being particularly aggressive. A strain isolated from cabbage was very destructive to broad beans, vetch, and *L. angustifolius* and moderately so to peas, while two from potato [ibid., xv, p. 586 *et passim*] were generally harmless, though one caused heavy damage on *L. angustifolius*. The infective capacity of species of *Fusarium* was much slighter than that of *C. solani*, some strains of *F. solani*, in fact, being non-pathogenic. Both *C. solani* and *F. spp.*, however, consistently induced the reddish-brown discoloration of the central cylinder which was absent in the material inoculated with members of the *Ascochyta* group.

Union of South Africa. Proclamation 155 of 1939. Restrictions on the importation of Potatoes.

From and after 1st February, 1940, the Union of South Africa Proclamation 286 of 1936 [*P.A.M.*, xvi, p. 640] is amended to prohibit the introduction into the Union from overseas, Portuguese East Africa, South West Africa, or any place in Africa north of the Zambesi, except Northern Rhodesia, Nyasaland, and the Belgian Congo of any consignment of potatoes unless certified in the country of origin as officially inspected in the field, as sufficiently free from virus diseases to be suitable for seed purposes, and as not grown in the vicinity of unhealthy potatoes or other plants affected with potato virus diseases.

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